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Kenya Says *Harambee!*

By ALLAN C. FISHER, JR.
Senior Assistant Editor

Illustrations by National Geographic Photographer BRUCE DALE

ERECTLY, WITH JUST A HINT of arrogance in the set of his thick shoulders and the upward thrust of his head, the Old Man stood before the crowd. So that all could look full upon him, he turned from side to side his patriarchal face: gray bearded, broad and brooding, the slightly protuberant eyes shining moistly from amidst the black skin. His right hand, clutching the ever-present fly whisk, swept upward in a theatrical gesture no field marshal with baton could have hoped to match.

Old lion, how impressive you are. In my thoughts I paid him tribute. You are lord of the pride, and everyone here acknowledges it.

In a clear, commanding voice the Old Man called out, "*Harambee!*" (Hah-rahm-BAY!).

From the massed thousands, like a single thunderous echo from encircling cliffs, the word returned, "Haaa-raaam-BAYYY!"

They are with you. They love your every practiced move. In you they see themselves one people, one nation.

His Excellency Jomo Kenyatta, once convicted as leader of the dreaded Mau Mau terrorists, now President of the Republic of Kenya, consistent exponent of racial tolerance, self-help for nations, and moderation in politics, and in the opinion of many the premier statesman among the new African nations, had come to his home district of Gatundu to dedicate a new hospital. As always in his public appearances, he had not missed the

opportunity to exhort the crowd with the cry of "Harambee," a Swahili word meaning "Let us all pull together," picked by President Kenyatta as the national motto. It signifies Kenya's attempt to make a place for itself among the world's stable and prosperous nations.



EDUCATION Q. 1969

Old lion of Kenya, Jomo Kenyatta leads his fledgling nation along the path toward self-help, hard work, and racial good will. Here, over a Voice of Kenya microphone, he calls on Kenyans of all tribes to forget grudges and unite for future greatness. From his wrist dangles a silver-handled horsehair fly whisk, or *mgwisha*—a Kenyatta trademark.





To nearly all his countrymen President Kenyatta is simply the "Mzee" (Muh-zAY), another Swahili word, literally translated the "old man"; in east Africa it is a title of the greatest respect and affection. On this occasion the Mzee, speaking from a tent-shaded dais in an open field, waxed evangelistic in his fervor. The hospital in the Gatundu countryside had been his idea, a self-help project contributed to by thousands of Kenyans. Though he harangued the crowd in Swahili, the lingua franca of east Africa, he spoke several times the English words "self-help," and, on one occasion, the expression, "Actions speak louder than words."

Handshakes Bring Help for New Hospital

Then, to my astonishment, he turned the dedication ceremonies into a fund-raising rally for the hospital. Long lines formed in front of the dais, and in 50 minutes, in exchange for a handshake from him, the Mzee had collected one chicken, one sheep, the promise of a pint of blood, and in hard cash 43,250 Kenya shillings (approximately \$6,100).

My astonishment was not permitted to wane. When the collection ended, thousands of tribal dancers and singers from all over Kenya streamed onto the huge field. After a time any ordered program proved impossible, and the field became a colorful, swirling melange of bizarre costumes and sweaty bodies amidst a cacophony of drums, bells, rattling gourds, chants, and exuberant outcries. Even the Mzee abandoned his reserve, and when last I saw him, he had joined a group of pretty Somali tribeswomen and was clapping a cadence for their dance (opposite).

It had been a highly entertaining show. But to me, and no doubt to other foreigners present, the occasion also revealed much and taught much. The central and most important factor influencing the emerging new nation of Kenya is the formidable Jomo Kenyatta himself. And, in dramatic fashion, we had seen a demonstration of his hold upon the people and the philosophy of unity and self-help he so constantly and tirelessly preaches.

Pulsing sounds and flashing colors climax a hospital dedication in Gatundu by President Kenyatta. These Somali women, whose tribe in the past has wavered in its allegiance to the government, join in the spirit of the occasion. After five years of independence, the drums of nationalism beat hard in Kenya—where more than 70 tribes must learn to march to the same rhythm.

Kenyatta, now in his late seventies, began his career as a leader of a political group within his tribe—the Kikuyu—that sought self-government for Kenya under the African, or Negro, majority. Well educated in Kenya and England, he lived in London many years. In 1952, when the British declared the Mau Mau emergency, he was seized, tried, and convicted as leader of the murderous secret society. After nine years in custody, he returned to the political scene as a virtual martyr in the eyes of all of Kenya's more than 70 tribes, the one man with truly national prestige and influence.

Today he has no obvious heir apparent, and his death, many observers feel, would leave a vacuum that might well result in a power struggle and public disorder.

The question of whether or not Kenyatta directed the Mau Mau—he steadfastly maintains his innocence—must be left to future historians. But this much is certain: Kenyatta, in his earliest public utterances, and in speeches before and after the Mau Mau uprising, urged orderly, lawful change. Prior to Kenya's independence in December 1963, he was saying, "There must be no revenge. . . . Our aim is to bring people of all races together: . . . All

Dampened but undaunted, traffic flows through downtown Nairobi, following an afternoon deluge that left streets brimming with four inches of rain. Erratic yet plentiful rainfall nourishes abundant crops in Kenya's highlands, where altitudes above 5,000 feet temper the equatorial heat that bakes adjacent regions. The invigorating climate of



citizens will be equal in the eyes of the law. . . . We desire to bring love where there was hatred, peace where there was violence. . . . Mau Mau was a disease which has been eradicated, and must never be remembered again."

As his country's first Prime Minister, and now its first President, the Mzee has given evidence of meaning precisely what he said. Kenya, a land a little larger than France and Belgium combined, has a population estimated at 10,000,000. More than 97 percent are Africans, the rest Europeans, Asians, and Arabs. Kenyatta obtained a constitution

guaranteeing equal rights with the Africans for all citizens from minority groups.

European farmers, though they comprise only a fraction of 1 percent of the population, once owned 25 percent of all arable land in private hands. In recent years more than 1,500,000 acres of this land have been voluntarily sold at fair prices to Africans, a continuing program that has been singularly devoid of rancorous public discussion. The Kenya Government, showing scant interest in theoretical "isms," respects private-property rights and encourages foreign investment. Between 1962 and 1967 United States

these breeze-cooled highlands attracted thousands of European farmers who cleared forests and broke the soil to farming during the early 1900's.

Proud young *moran*, or warrior, of the Masai tribe wanders with his cattle across the scorched earth of the Amboseli plains. The animals provide the Masai—who measure wealth by the size of herds—with a food supply of blood, milk, and meat.

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ENTRANCE GATE TO THE HIGHLANDS OF KENYA



KENYA

WASHED BY THE INDIAN OCEAN on the southeast and huge Lake Victoria on the southwest, Kenya is neighbor to five nations. With towering mountains, and forests that teem with majestic wildlife—much of it within the protective confines of national reserves and parks—Kenya is a showcase of scenic wonders. The east African country obtained independence from Great Britain in 1963, but has retained her ties through membership in the Commonwealth.



AREA: 224,960 square miles. **POPULATION:** 10,000,000—97 percent Africans, the rest Asian, European, Arab. **LANGUAGE:** Swahili, English, tribal. **RELIGION:** Tribal, Christian, Moslem. **ECONOMY:** Agriculture: coffee, tea, pyrethrum, sisal; tourism; light industry. **MAJOR CITIES:** Nairobi (pop. 350,000), capital; Mombasa (pop. 170,000), port.

INDIAN OCEAN

Broad-shouldered highlands, gashed by the lake-spattered Great Rift Valley, lift nearly a third of Kenya a mile or more above sea level. On this lofty plateau and western hills near Lake Victoria live most of the nation's people. Elsewhere, except along the humid coast, Kenya consists largely of semiparched scrubland and searing desert.

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interests alone accounted for 49 new business ventures.

Meanwhile the Mzee, who put his muscle behind all these policies, tours the land like a dedicated circuit rider, speaking eloquently and often bluntly. His themes are nearly always the same: Reject tribalism . . . we must be one people, one nation . . . work hard . . . seek education . . . practice tolerance . . . support the law and your government.

And the people of Kenya, a country torn by bloody insurrection a scant 15 years ago, listen to the Old Man—and obey. I myself have reaped some of the benefits. For nine weeks I traveled that lovely land, without government escort, often in places no tourist ever sees, and several times in areas where Europeans rarely venture. Not once did I encounter any manifestation of ill will because I was white. In Nairobi, Kenya's modern and handsome capital, I felt safe on the streets at any hour.

Problems Plague a Young Nation

Though its present stability has been hailed as a model for other nations of black Africa, Kenya is no utopia. Far from it. Beneath the surface strong racial antagonisms do exist. Nearly all the 185,000 Asians and 42,000 Europeans had the choice of British or Kenyan citizenship at independence. Large majorities of both groups chose British. Now the Kenya Government, amid charges of racial bias, is forcing these non-citizens out of their jobs, and often out of the country, in a long-range program of "Kenyanization," or "Africanization" (pages 168-9).

While Kenya's top government officials are often well educated and very able, there is little talent beneath them. The result is a paralyzing bureaucracy. Most Kenyans are illiterate, and, despite heroic efforts by the government, some 30 to 45 percent (estimates vary) of the nation's children never attend school. Add to these problems the cruel fact of widespread poverty, and the stability of the Kenyatta regime seems all the more remarkable.

I explored these and numerous other problems and developments in my quest for the story of modern Kenya. But happily there still exists another Kenya, timeless and unchanging, the vast Kenya of the lion and the elephant and the antelope, of magnificent distances where one's spirit roams with the wind in a land so beautiful that it seems to cleanse the soul of the beholder. This is the Kenya I sought first, traveling mostly by



From isolated outpost to modern showplace, Nairobi has ridden Kenya's tide of progress. This mile-high capital of 350,000, one of Africa's biggest cities, began only seventy years ago as a makeshift camp on the pioneering Kenya-Uganda Railroad. Dubbed the "safari



ILLUSTRATION BY NATIONAL GEOGRAPHIC SOCIETY

capital of the world," it sends streams of hunters, photographers, and sightseers into Kenya's game-rich hinterlands. Haze-veiled Machakos Hills rim the southeast horizon. Nairobi National Park, a 44-square-mile game sanctuary, lies only a lion's roar south of the city.



Land-Rover during long, golden days, living under canvas in the bush during crisp, star-filled nights (pages 172-3).

How vividly the mind's eye brings back certain scenes. . .

- First dawn at Tsavo National Park. Something soundless but compelling awakens me. I do not understand, but I know I must go to the door of my tent. Not 40 yards away, his bulk a gray cliff against the resurgent light, a huge bull elephant grazes. He sees me, takes a step in my direction. Then perhaps he senses my admiration and good will, stronger even than my fear. The grazing continues; we feel comfortable with one another. Finally he ambles off.

- Blazing midmorning at Masai Mara Game

Reserve. The big male lion, his appetite sated, tugs halfheartedly at the remains of the buffalo carcass. Flies rise like a puff of smoke. The stench permeates our Land-Rover. His full belly distended into a pendulous paunch, the lion walks away, ignoring our presence.

- Early morning at Masai Amboseli Game Reserve. The elephant herd, 43 strong, ambles through the dust against the magnificent backdrop of the snows of Kilimanjaro across the border in Tanzania. Soon the herd almost surrounds our Land-Rover. We start the engine; the herd bolts; one old bull trumpets and charges. Wheels spraying dust, we lurch away to safety.

- Night, blackest night, in northern Kenya. Monsoon rains engulf our vehicle like a fall;



BOUCHERON/REUTERS © R.E.S.

Tense trio follows the action at Nairobi Racecourse, once an exclusive rendezvous for Kenya's white residents. Today a growing number of Africans and Asians enjoy the sport.

Hoofs pulverize the turf around a turn. Track crews must occasionally root out such hazards as six-foot-deep ant holes—reminders that, despite the fashionable setting, this is still Africa.

under the headlights, the road becomes a river. In the dark, in this timeless wilderness, fantasy becomes reality, and we are adrift in some primeval flood, the water ochreous from the wounds of the land's violent birth. Then in the morning a lovely miracle. All the many thorn trees, low, gnarled, gaunt, bear tiny white blossoms—gift of the daily rains.

Happily, Kenya makes it possible for just about anyone to enjoy similar experiences. When the government looks at its scenery and wildlife, it sees money—lots of beautiful green foreign exchange. To lure tourists, Kenya not only preserved and improved British-initiated wildlife conservation areas but also added numerous others. Today, with technical and financial help from the United States and

other countries, Kenya supports 23 parks and reserves. In adjacent areas called "shooting blocks," licensed hunting is allowed.

The government administers its parks through a board of prominent citizens. Game reserves come under local county councils, with supervision by the Ministry of Tourism and Wildlife. Whatever the method, good conservation practices result, and visitors enjoy excellent lodge and camping facilities. In 1967 Kenya counted 127,000 foreign visitors, most of whom came to see the wildlife.* Today tourism is the nation's fastest growing

*See, in *NATIONAL GEOGRAPHIC*: "Where Elephants Have Right of Way," by George and Jinx Rodger, September 1960; "Africa's Uncaged Elephants," by Quentin Keynes, March 1951, and "Roaming Africa's Untethered Zoon," by W. Robert Moore, March 1950.

industry, second only to agriculture as an earner of foreign exchange.

This has not been accomplished without some opposition and difficulty, notably from the native scratching out a living in the bush. He sees wild animals as meat or menace; either way, he wants them dead.

"The buffalo eats his crops; so does the elephant. And either one can kill him," explained A. P. Achieng, Permanent Secretary in the Ministry of Tourism and Wildlife. "In the hunting areas he sees a foreigner shoot a trophy, take the head, and leave the meat to rot. But if he, a citizen, kills a dik-dik for food without a license, he gets thrown into jail. This is very hard for him to understand."

So, with exhibits, talks, literature for the schools, and sponsored park tours, the government impresses upon the people that their wildlife is a money-earning national asset. The foreigner pays a stiff fee to shoot a trophy, the government points out. Indeed, hunting big game in the shooting-block areas can be very expensive; you must employ a safari company and professional hunter.

Nine-tenths of the foreigners attracted by Kenya's superb wildlife come to look and photograph, not to shoot, and they can choose from a wide price range of escorted tours. On a limited budget? Perhaps you will want an all-expense package tour. At times such groups, scurrying about on tight schedules in little zebra-striped minibuses, seem to outnumber the animals. Money no object? Perhaps your taste will run to an air safari, in which you fly about Kenya in your own chartered plane and are met at each stop by your own private vehicle.

In between these extremes you will find safari companies that specialize in taking outdoor-loving groups into the bush under canvas, and other companies that book your lodge reservations and provide a car and guide. Setting out on your own in a rented car is possible but difficult; accommodations at the parks and reserves, though being expanded, sometimes are booked solid months in advance.

Much of Kenya's highly varied terrain,

ranging from tropic seashore and high mountains to flat plains and the deep cleft of the Great Rift Valley (map, pages 156-7), seems ordained by nature as a wildlife habitat. More than half the land is arid or semi-arid, and about 80 percent of the human population lives in only 15 percent of the land area, mostly in the Lake Victoria basin and the highlands, where enough rain falls for a rich and varied agriculture. Elsewhere wild animals, more adaptive than man, roam a virgin land; some of it supports thick forest, but vast stretches remain too dry for the plow and often too harsh a challenge for all but the toughest pastoral tribes, such as the Masai.

"Fantastic Support" for National Parks

Perez M. Olindo, the dedicated young Director of Kenya National Parks, looks upon his domain and finds the situation good.

"We are enjoying fantastic support from the government in our game conservation efforts," he told me. "It is our policy to give adequate protection to all species, but not to take more land than is needed. When the parks system is finished, about 12 to 15 percent of the nation's land area will be included. It would not be reasonable to take more. We must be able to defend what we have."

Care has been taken to set aside different kinds of parkland and reserve. For example, Aberdare and Mount Kenya parks typify the forested mountain sanctuaries; Samburu and Marsabit in the remote north, wild desert scenery; Tsavo and Masai Amboseli, flat, sandy bush; Masai Mara and Nairobi, the park just outside the capital, rolling grasslands.

Recently the government established two marine parks, protecting coral reefs off the coast, and at Lake Nakuru it has under its wing, so to speak, the world's largest concentration of lesser and greater flamingos, sometimes numbering an estimated 2,000,000. Seen from the air as they feed in the shallows, these magnificent birds look like windrows of pink petals cast up on Nakuru's shores (pages 178-80).

One finds it difficult to express a preference

Collision of cultures has had a jarring impact on this gum-chewing Kikuyu tribesman dressed in his best for a celebration. His improvised ensemble includes an auto-headlight rim. Kikuyus, the tribe of President Kenyatta, comprise about a sixth of Kenya's population and play a dominant, though not domineering, role in national politics. Most other tribes join them in chanting the national motto, *Harambee!*—"Let us all pull together!" Only a few tribes, such as the Masai and Turkana, still turn their backs on the 20th century.





Shapers of the future stop to chat between classes at Kenya Science Teachers' College near Nairobi. A modern water tower dominates the campus, opened last year. Sweden sponsors and staffs the school, which turns out about 100 secondary-school science teachers a year. Despite such progress, great educational strides are needed in a land where a third or more of the children never see the inside of a classroom.

among these areas, but I think mine must be the southern sanctuaries, Mara, Amboseli, and Tsavo, with their sky-reaching expanses of oat grass, tawny as a lion in the sun, darkened with the occasional ink blots of cloud shadow and the wizened forms of thorn trees.

Stay in Your Vehicle!

Staff photographer Bruce Dale and I marveled at how indifferent the animals were to our Land-Rover. Most of them ignored it; others seemed curious. "We don't look like humans while we are in this vehicle, and the oil and petrol fumes mask our scent," explained our safari leader, Ed Penfold. "But watch what happens when I get outside, away from the car."

Ed stood quietly by the bumper. Nearby herds of topi and Thomson's gazelle stampeded in panic. "Don't ever do that yourself," Ed warned. "Being afoot in the bush can be very dangerous."

Just how dangerous I learned later that same day in conversation with Maj. Evelyn Wood Temple-Boreham, senior game warden for all southwest Kenya, a man whose physique and handlebar mustache are as impressively proportioned as his name (page 176).

"Animals have killed 31 people—all Masai tribesmen—in my jurisdiction during the past three years," he said. "Cape buffalo got a number of them. They're treacherous beasts. I've known them to hide in brush by a water hole, wait for native women to come and fill their jars, then rip the women up the back as they start home."

Buffalo, in the opinion of hunter John Cook, are the most dangerous of all big game. Until recently, Cook, armed with a rifle, escorted tourist groups the several hundred yards they must walk through forest to get from road to Treetops, the famous hotel perched high atop pilings near a water hole in the Aberdare National Park. From balconies or topside deck at Treetops you can watch many species of animal come to drink, unaware of your presence

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overhead (pages 174-5). Late one afternoon Cook and I counted 47 buffalo plodding toward the water hole like a tranquil herd of black Angus cattle.

"A buffalo came at me once very suddenly from behind a huge boulder," Cook recalled. "I got off one shot, hit him in the throat. He fell dead on, not at, my left foot. Tough beasts. I've blown a hole that you could see through in a buffalo, but still it came on."

The path to Treetops is spotted with stout log barricades that people can dodge behind if charged by buffalo, elephant, or rhino. This happens rarely. I asked Cook if he ever had to shoot to protect his wards.

"No, and I've been doing this work for more than three years. Just recently, though, five elephants got after the group I was escorting. Only one old bull really seemed determined. He screamed and bellied up to me, but then changed his mind and went off."

Several weeks after my visit to Treetops, a cow elephant had to be shot by another hunter to protect an elderly woman. The animal fell dead less than 15 feet from the terrified tourist.

Kenya's Wildlife Stirs the Emotions

I had thought I detected in Cook something I had also noticed in Temple-Boreham. Tough veterans of the bush, both, and unsentimental, but each seemed to take on a certain softness of tone, a voice tinged with emotion, when he spoke of his attachment to Kenya's wilderness and wildlife. So did actor William Holden, another veteran of the Kenya scene, a hunter, conservationist, and part owner of the plush Mount Kenya Safari Club.

Could Holden's feeling for Kenya be described as love at first sight?

"Yes, it happens occasionally in love affairs," said the star of many screen romances.

Holden and several other partners have a 1,260-acre game reserve adjacent to the club grounds. In my opinion it introduces to the surroundings a needed note of reality. The posh resort, with its luxury cottages and pampered grounds, seemed to me as far removed from the real Kenya as a Kansas country club.

Very real, however, is the resort's magnificent backdrop, snow-capped Mount Kenya, at 17,058 feet the highest mountain in the land (page 188). A guide took me by logging road high into its drenched forest; amid the swirling mists and the sighing trees, the mountain's legends seemed quite believable.

Kere-Nyaga, Mountain of Brightness; it is called by the Kikuyu, largest of Kenya's



ENCOURAGES BY W. K. A.

Spellbound students compound nitrobenzene at Kenya Science Teachers College. They study tuition-free, then are expected to teach at a government-selected school—perhaps in a remote town.

Putting the pieces together: A skilled worker in a Nairobi factory helps assemble truck parts imported from Britain. Creation of a trained labor force is one of Kenya's top-priority goals.







tribes, and to them it is holy, the earthly dwelling place of Ngai, God. In Kikuyu legend the mountain was fashioned by Mogai, the Divider of the Universe, and when he had done so, he took to its top the man Gikuyu, founder of the tribe. He showed Gikuyu the beauty of the land, and, pointing to a spot full of fig trees, commanded Gikuyu to descend and establish there his homestead. This he did, and ever since then the Kikuyu when praying turn toward the Mountain of Brightness and with upraised hands offer sacrifices.

President Kenyatta tells this legend in his book *Facing Mount Kenya*, a scholarly account of the Kikuyu tribe first published in 1938 when he was a student of anthropology in London. Knowing that legend, one can better understand the Mau Mau, nearly all of whom were Kikuyu. In their eyes the land given their founding father Gikuyu by Mogai had been stolen by the white man.

Old Grievances Led to Bloody Uprising

White settlement in Kenya's interior did not get under way until the British completed the railway from Mombasa to Lake Victoria in 1901. The path of empire had been blazed by a handful of redoubtable missionary-explorers who penetrated east Africa in the mid-19th century. Before that, Arabs and Portuguese, coastal settlers from olden times, had confined their interest in the interior to raids for slaves and ivory.

In the vanguard of the British strode Lord Delamere, a wealthy young peer with determination to match his purse; he found much of the well-watered highlands sparsely populated by natives, demonstrated the land's potential for European farming methods, and started the influx of white settlers. The Kikuyu, however, always regarded this territory as part of their homeland; they claimed they had left it temporarily not long before the coming of the white man because of famine and disease that swept the area.

Smoldering resentment over land and other grievances finally flared up in the Mau Mau uprising of 1952-56. But many Kikuyu, as well as other tribesmen, could not stomach the obscene oaths of membership required by the secret society, or its terror tactics, and Africans, not Europeans or Asians, did most of the fighting and dying in resistance to Mau Mau. Of 2,356 Africans officially counted as killed by the terrorists, 1,832 were civilians, the remaining 524 being members of the security forces. Although attacks on white farmers received great publicity, only 32 European civilians and 63 Europeans in the security ranks died. The total toll of Asians was 29. On the Mau Mau side, 11,500 were killed.

When the blood bath ended, the land problem remained. Africans still were not permitted to own land in some richly

"Give us land!" The cry of Kenya's Africans has been answered for many. Colonial law barred them from owning the choicest land, and relatively few were permitted to grow coffee and tea in competition with whites (called Europeans). These green checkerboard fields near Kisii, formerly owned by Europeans, have been bought by the government and resold to African smallholders. Some former estates have been kept intact and now are run as cooperatives.



Bidding farewell to friends in Nairobi, this Kenya-born Indian hoped to reach England before a British law curbing Asian immigration went into effect in March 1968. Thousands of Asians, who after independence had opted for British rather than Kenyan citizenship, rushed to beat the immigration deadline.

productive agricultural areas. Moreover, in practice the great majority of Africans were excluded from the rich return offered by such cash crops as coffee and tea. Under colonial law, these crops could be grown only on plots of five acres or larger—ostensibly so that the detection and control of plant disease would be easier—and few Africans owned plots that large.

The British Government itself had ended

these restrictions by 1959, four years prior to Kenya's independence. And in 1961 it began the purchase of 1,000,000 acres of land from Europeans for resale to landless Africans on liberal loan terms (preceding pages).

In the opinion of Bruce McKenzie, Minister of Agriculture, the program came just in time to prevent renewed strife.

"The kettle was not only steaming, it was boiling and about to blow up," he told me. "But now the steam is out of the kettle."

The British land-transfer program and several related projects, totaling about one and a half million acres, have been completed under the Kenya Government. Now, with financial help from various international sources, Kenya is in the midst of acquiring some 600,000 additional acres from non-citizens for sale to Africans, mostly smallholders whose farms usually do not exceed 15 acres. Other Africans, however, qualify under yeoman or large-scale farm programs, and their properties are considerably larger.

"We have taken fairly good care not to break up those farms that are highly valuable to the economy," said Mr. McKenzie. The Minister of Agriculture is one of the best-known men in Kenya, partly because of his famous muttonchop whiskers and luxuriant mustache and partly because he is the government's only white minister, but mostly because of the extreme difficulty of his job.

Kenya's economy depends upon agriculture: at least three out of five jobs are farm-connected. Mr. McKenzie has to protect this vital sector of the economy against too-rapid Africanization and keep it productive, meanwhile serving as the bridge between two races. The political opposition in Parliament favors expropriation of European-owned land without payment, and this the Agriculture Minister, speaking for the government, stoutly resists.

According to Mr. McKenzie, "nobody is

forced to sell" his land. That is indeed government policy, and so far there seem to be enough non-citizens within the European community who are willing to dispose of their property. But as one white farmer, still holding on, told me, "Africans can and do force us out; if the blokes won't work for you, how can you farm?"

Despite such problems production holds up, as I saw for myself in a swing through the agricultural heartland to the north and northwest of Nairobi. Here too, as in the game areas, the land has been blessed with beauty—but a soft beauty, often lush and verdant.

At Kangaita the government hewed from forest the land for a tea nursery. From a dis-

a tray is full, the farmer knows he has a hundred. With the trays he can keep his own count; he doesn't like to depend on us."

There is still another reason for the trays. Some tribesmen have a superstitious aversion to making a count of living things, believing it brings bad luck. With the tray system, they need not make the actual cutting-by-cutting count.

The nearby forest looked awfully dense and dark. I asked the foreman if the men were ever troubled by wild animals.

"Elephants," he said grimly. "Sometimes we can frighten them off with thunder flashes, a noisy but harmless explosive. If that doesn't work, we call in the Game Department to drive them off or shoot them."

Mau Mau Prisoners Launch Rice Plan

One of Kenya's most interesting agricultural developments, the Mwea Irrigation Settlement, began under the British as a construction project to keep detainees busy during the Mau Mau uprising. Prisoners built an experimental system for growing rice in a sparsely settled valley 60 miles northeast of Nairobi. Today, with water tapped from the Thiba and Nyamindi Rivers, both fed by the rains and snows of Mount Kenya, the valley has become a green oasis; 8,000 acres of identical rice paddies stretch away to the horizon like an infinity of mirror images.

The project, still growing, now supports nearly 2,000 families. I met one such family while walking along a dike toward a flock of birds raiding a ripe but unharvested plot. A farmer, his wife, and small son clambered barefooted through a muddy ditch and onto the dike; they had just gathered the last grains on their four-acre field.

The man's English was fragmentary and halting, but he got his feelings across to me.

"There," he said, pointing to his plot. "Mine. It is good?"

"It is very good," I replied.

He tapped his chest and again said, "Mine, the land mine. But someday for him," and he looked at the boy. Then the family walked on, leaving me with the memory of three very happy smiles.

Many problems beset the government when it puts its landless citizens onto farms. For example, not a single family settled at Mwea had any previous experience growing rice. Moreover, most Africans know only a subsistence kind of agriculture on small plots. The government had to develop a special school, the Thomson's Falls Farmers Training



STYLING BY BRUCE JANE © R.S.L.

Her future at stake, an Indian child awaits departure from Nairobi during the 1968 immigration crisis. Many failed to reach Britain in time. Unable as non-citizens to find jobs in Kenya, they had to look elsewhere for a new homeland.

tance, close-packed, thick tea bushes looked like rolling lawns carpeting the hillsides. The nursery was on the eve of an influx of workmen who would distribute to African farmers 600,000 cuttings a day for planting on their farms. A foreman showed me stacks of trays, each with openings to hold a total of 100 cuttings.

"Many of the farmers cannot count," the foreman said. "So we devised these trays. If

College, to prepare people to take over larger farms of 200 to 3,000 acres. The college, a handsome property of 950 acres, formerly a boarding school for European children, gives an 11-month course to 102 students each year.

"It is an entirely new world for them," said William M. Spencer, the white principal. "Some have never slept in a bed, and many have never used a lavatory when they come here. But they are terribly enthusiastic. If they weren't, I think we'd all go home."

I interviewed each member of a class in tractor operation: 11 students, a smiling, affable lot ranging in age from 21 to 46. A pattern soon emerged in their answers. One man said he had been picked to run a 2,500-acre farm owned by a group of 50 people; another said he would manage a 4,000-acre farm bought by a group of 59. Others told similar stories of multiple ownership, and several of the men

had been sent by the Agricultural Development Corporation, a government body, to be taught how to run government-owned farms. Not until I talked to members of a dairy-hygiene class did I find two men whose fathers owned large farms.

"Few individuals can afford such properties," explained Mr. Spencer, himself a former farm owner. "In the past, Africans saw European farming practices only from a laborer's viewpoint. We are one of the few institutions in the world that are taking people from a peasant population and putting them directly into a highly developed agricultural system."

Business Suffers From Shortage of Skills

Essentially the same problem—sudden responsibility thrust upon inexperienced Africans—plagues the nation's commerce and industry. For generations Kenya's stores and

Challenging the land, an entrant in the East African Safari Rally growls up an escarpment of the Great Rift Valley. The annual motor race, the world's most punishing for man and machine, zigzags across more than 3,000 miles of brutal terrain in Kenya, Uganda, and Tanzania. Of 91 starters last April 11, only 7 clanked and wheezed to the finish four days later. Twice



shops, its civil service, and many skilled trades were manned very heavily by Asians, whose forebears were imported from India by the British to build the Kenya-Uganda Railroad. In small villages and towns Asian dominance of trade was virtually complete; Africans dealt with the *dukawallah*, the Asian shopkeeper, or went without. As for the Europeans, they ran the government, owned nearly all the larger farms and bigger businesses, and staffed most of the professions.

"In Kenya the African has always resented the Asian and felt badly used by him," a well-informed foreign observer told me. "The Asians have been a standoffish lot, clinging rigidly to their own customs and ways and kind. Perhaps curiously, the Africans get along better with the Europeans and resent them less. The average native can aspire to many of the jobs and shops of the brown man,

but not yet to the position of the white man."

As my informant put it, "No nation can afford to have its economy dominated by foreigners." So the Kenya Government, through a system of work permits and trade licenses, has launched a determined program to oust non-citizens from their jobs and replace them with citizens. So far this has usually meant replacing Asians with Africans. The government has classified all jobs into 11 categories, and only the lowest posts and those easiest for Africans to fill have yet been affected.

Inevitably this Africanization has created racial ill will. Asians now are the ones who feel badly used. They acknowledge their clanishness but do not think they need apologize for it. They also claim that fully one-third of more than 20,000 applications for citizenship filed by Asians prior to the deadline in December 1965 have been left unprocessed—a

during the race each car must plunge into, then clamber out of, the depths of the Rift—that colossal fracture which splits the earth's crust from southeastern Africa to Syria. In places half a mile deep and 30 to 40 miles wide, the great fault bisects Kenya's highlands and cups Lake Rudolf in one of its depressions (map, page 156).



Trailing plumes of golden dust, the author's Land-Rover (right) traverses the Masai Amboseli Game Reserve at sunset. Dusk finds him back at his safari camp (below), jotting down details of a memorable day in the wilds.

Each morning during the safari, he and his companions depart from camp for a day-long drive through Kenya's gamelands. While they are out on tour, a crew strikes the tents, packs all equipment aboard trucks, and heads off to a pre-arranged destination.

When the tired, dusty travelers arrive late in the afternoon, they find tents set up, campfires aglow, and dinner waiting to be served.



clear indication, they feel, of official bias.

Let's consider the typical case of a man we shall call Mr. Khan, who was fired from his job in the civil service. He applied for citizenship three years ago, but has not been accepted or rejected. Now he has a job as a salesman in Nairobi, but thinks he will lose it. "There are lots of opportunities here now, what with all the Asians leaving," he says, "and I've got an excellent job, so naturally I'd like to stay. But they want me out. I'll be forced to go, I'm sure, because I won't be able to feed my family."

Africans themselves, including a group of faculty members at University College in Nairobi, have counseled a go-slow policy of

Africanization, fearing severe dislocation of the economy. There have been indications of harm in agriculture, transport, meat packing, and other fields. I myself noted the effect upon the telephone service: getting through to government offices from my hotel, which involved two switchboards, took an average of half an hour per call.

Yet an impartial observer feels sympathy and understanding for both sides, and he looks with admiration upon a government that faces its problems bravely and, so far at least, conforms to due process of law in its differences with non-citizens.

Elsewhere on the economic scene, Kenya's

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Stately tusker roams a rain-laced forest

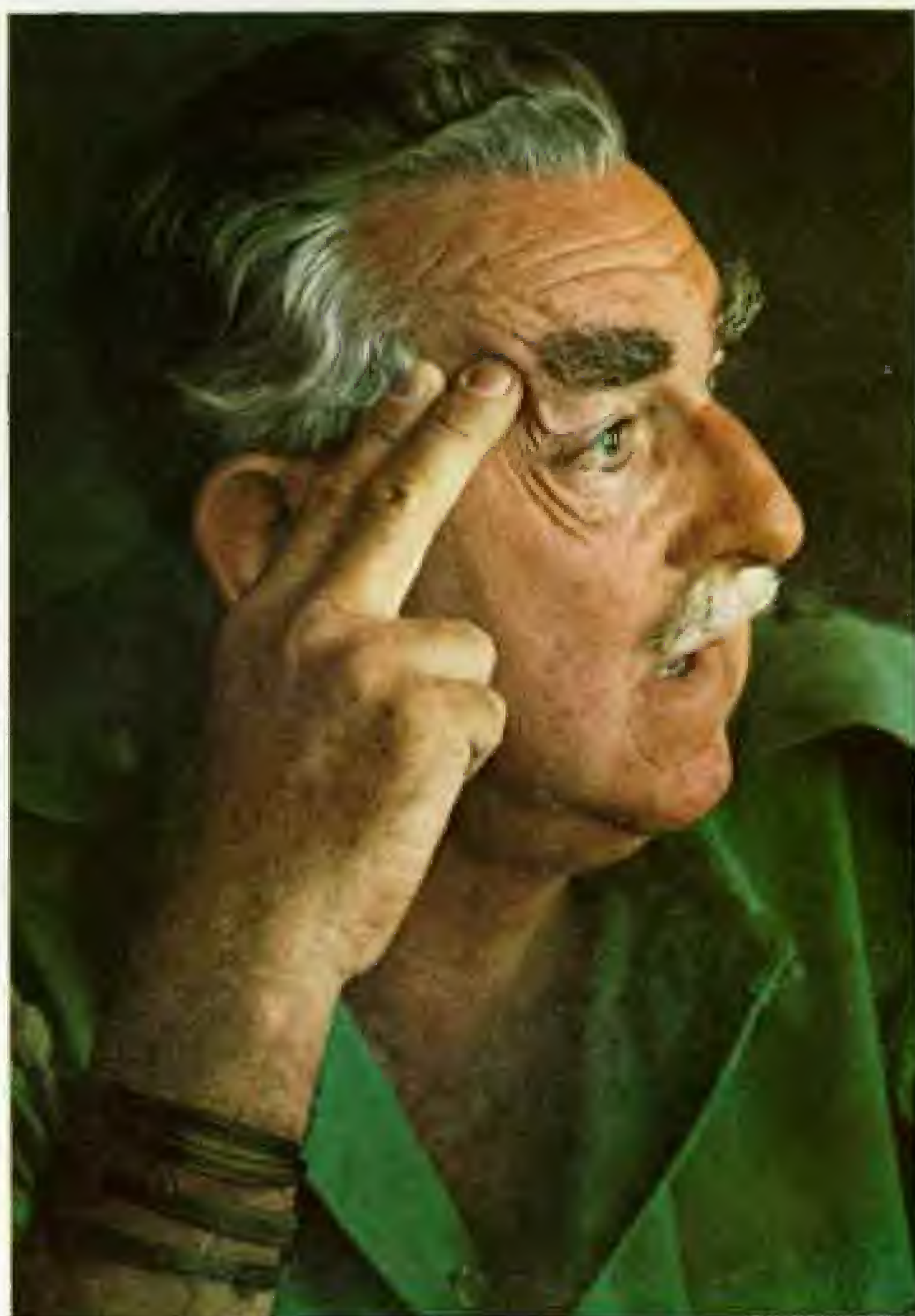
WITH MUTED FOOTFALLS, an elephant treads majestically across a clearing. Photographer Bruce Dale captured this scene from famed Treetops Hotel, built above a salt lick and water hole in Aberdare National Park. From their high-rise perch, guests view the parade of game below. A sharp eye helps spot shy creatures such as the waterbuck in the distance.

In less-protected areas gangs of poachers will lie in wait at a water hole until an elephant appears, then shower the hapless beast with poisoned arrows. After chopping out his tusks—for sale on the black market—they abandon his carcass and seek a new victim.

Before taking the photograph, Mr. Dale set up two remote-control, radio-operated cameras in some trees off to the left. Anticipating the rain, he wrapped the cameras in plastic, then returned to Treetops, where he planned to activate the shutters from afar at an appropriate moment. Later, the startled photographer looked out through the rain and spied two jubilant baboons swinging on his photographic equipment and plucking at the plastic. Fortunately, they fled empty-handed, and Mr. Dale retrieved his cameras—a bit damp but undamaged.







DETACHMENT © R. A. S.

Tough bush veteran, game warden Maj. Evelyn Wood Temple-Boreham told the author of the human toll taken by wild animals in Kenya's still-untamed bushlands. Thirty-one people had been killed in his jurisdiction over a three-year period. Treacherous Cape buffalo, known to lie in wait for victims by water holes, cause the most trouble, he says.

The major, one of a dwindling number of European administrators in Kenya, battled the deadly Mau Mau terrorists in the 1950's, and now supervises poacher-endangered gamelands as senior warden for all southwest Kenya. On his wrist he wears good-luck charms—elephant-hair bracelets.

situation is less troubled and the outlook brighter. The government espouses something it calls African Socialism, which misleads many people; certainly its brand of socialism is far more pragmatic than doctrinaire, with emphasis put upon private-property rights. Foreign investment has been encouraged.

"We simply do not have enough of our own local savings to carry an industrial program through," said Joseph Muliro, the young and able Acting Undersecretary in the Ministry of Commerce and Industry. "Our people have not enough resources and experience. Therefore we have put a lot of emphasis on foreign investment."

He explained that foreigners are permitted to realize a 120 percent return on their investment before having to pay any taxes. The government also protects them against imports that might compete with their Kenya-made products. In the past four years these

policies have brought into the country such blue-chip United States companies as Colgate-Palmolive, Union Carbide, and Crown Cork & Seal. United States interests have invested \$100,000,000 in Kenya, most of it since 1962.

Has the Africanization program been a problem in wooing and winning foreign investors?

"You can't expect someone to bring money in and invest it, and then deny him the opportunity to have his own people look after that investment," Mr. Muliro said. "Where very specialized skills are required, the need for expatriates is clear."

For years Kenya has enjoyed a more developed industrial and commercial base than its partners in the East African Community, Tanzania and Uganda. These three countries support a common market, communications system, international airline, associated col-

leges, and other joint ventures. Yet in numerous ways, notably their politics, they differ, and Kenya, with an annual growth rate of 6 percent in its economy, continues to outpace the others.

Social Change Sweeps the Cities

Kenya's healthy economy itself creates a problem, that of rapid urbanization. Seeking jobs and excitement, young people pour into the towns and cities, many already overcrowded yet growing at a rate of 6 percent or more each year. Trust an advertising man to capitalize on the temper of the times: "Be a City Man," said an ad promoting a Kenya-made product, City beer.

In Nairobi, in particular, the influx has meant social change. Take the old Norfolk Hotel, with its clubby atmosphere. It used to be exclusively for Europeans, mainly Kenya's landed gentry enjoying a visit to the capital. They still frequent the dining room, very British in manner, the look of genteel rusticity green upon them, but now you also see the occasional African or Asian face.

One day as I lounged on the hotel's porch, a spot much favored for luncheon or tea, a young, well-dressed African engaged in a furious altercation with one of the waiters. They spoke Swahili, but finally the young man, perhaps for my benefit, switched to English.

"You must see your own people too!" he said vehemently.

He thought he had been ignored by the African waiter in favor of a nearby table of Europeans. Possibly. But the African is being seen everywhere in Kenya today—and he is being heard and felt.

Yet the young man seeking city or town all too often finds his education woefully inadequate for the job of his dreams. Here, as in other vital areas, Kenya's problems bulk huge and granitic. An estimated 45 percent of the population is 15 years of age or younger. This high proportion of children places a heavy burden on the schools. Moreover, they must increase their capacity 2½ percent each year just to handle the increase in population. At present not much can be done to reduce the estimated 30 to 45 percent of the nation's children who never go to school.

Limited funds have forced the government to make a very painful decision: It gives financial support to colleges and some secondary schools, but not to primary schools. County

councils must support them, and they try valiantly, often giving the schools 85 or 90 percent of their slim budgets. Even so, all primary and secondary schools charge student fees. Costs may run as high as 680 shillings a year, or about \$97—extremely steep for the average African family.

"But an African has many people who can help him pay a school bill—wives, brothers, sisters, even cousins," said E. E. Khasakhala, Assistant Minister of Education and a Member of Parliament. "You assist any relative in school whose parents are poor."

That's just the way it works, I was assured by Bob Poole, who travels extensively in Kenya to direct the work of 260 United States Peace Corpsmen, 160 of them teachers. "Everywhere you go you find people paying school fees," he said. "There is a great pressure in the villages to send children to school."

Mr. Khasakhala sees little prospect, any time soon, of government financial support for primary schools. "We have worked out the figures, and we just can't afford it now," he admitted. However, he pointed out that the government does train and assign teachers, who are paid by the counties.

Typically, the Mzee himself came up with a partial answer to the problem: the Harambee school. Such self-help schools, built with the donated funds, materials, and labor of the people, grow slowly but surely, stone by stone and brick by brick, all over Kenya. Most serve the primary grades; others are secondary schools that, once operative, may obtain central government financial support. Into this latter category falls a little eight-room cinder-block structure whose dedication I attended at Sori. (Continued on page 183)

“... and let fowl
multiply in the earth.”

GENESIS 1:22

AS IF IN FULFILLMENT of God's commandment on the fifth day of creation, greater and lesser flamingos from a vast area of eastern Africa congregate in the shallows of Lake Nakuru to feed on algae that thrive only in intensely alkaline waters. At times an estimated 2,000,000 of the birds gather here. More than 40,000 lesser flamingos appear in this remarkable photograph.

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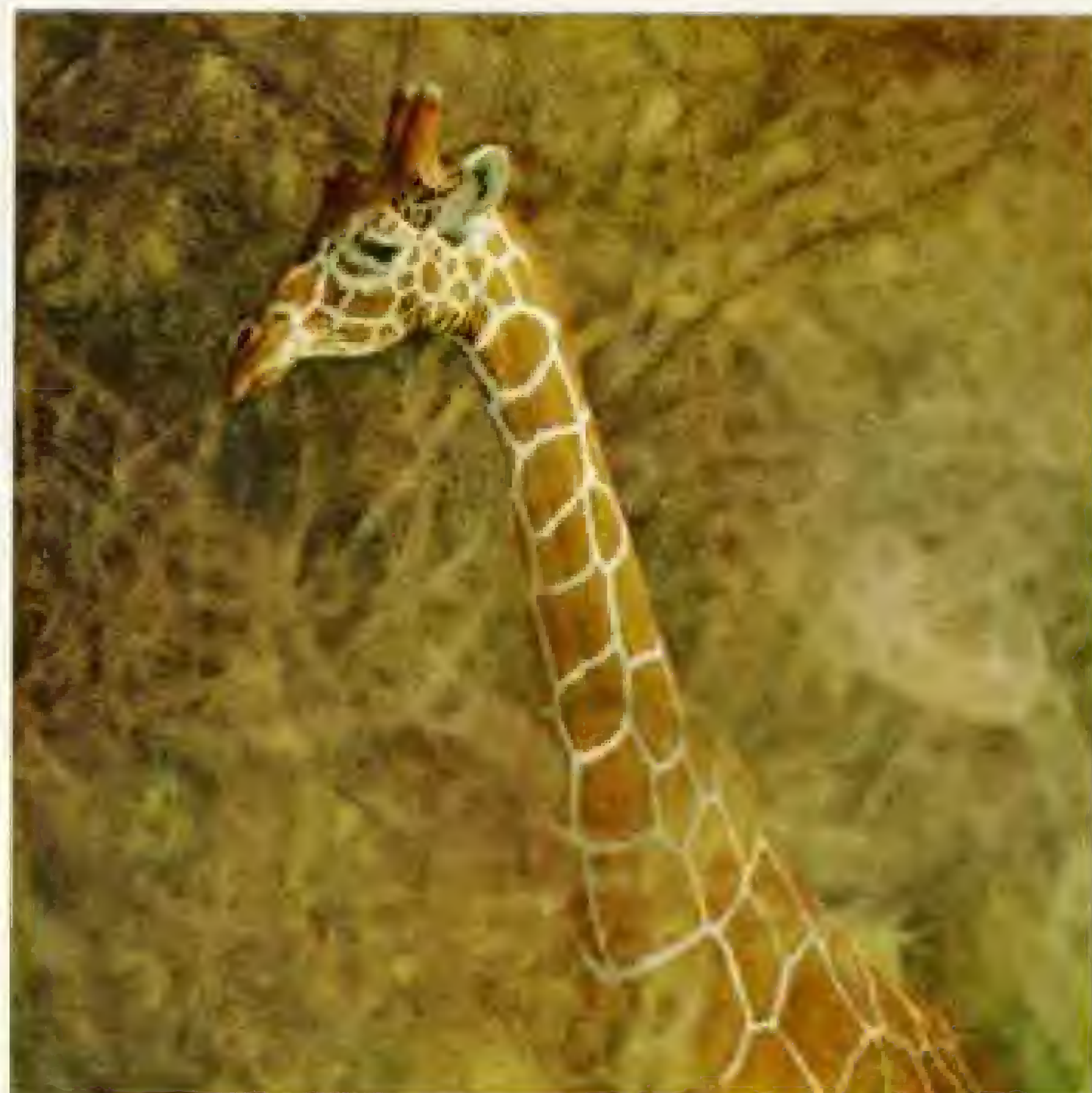


ILLUSTRATION BY NATIONAL GEOGRAPHIC PHOTOGRAPHY CENTER, 1991. N.G.P.



Camera trophies

PHOTOGRAPHERS, NOT HUNTERS, do most of the shooting in Kenya today. For a stiff license fee, hunters can still bag limited game quotas in special "shooting blocks." But nine of ten visitors—like the man aiming his lens through the roof hatch of a tour bus (right)—come to record Kenya's wonders on film and memory.

Few such wonders fill one with more awe than the sight of an 18-foot-tall reticulated giraffe swaying among treetops or lolloping along dry stretches of the Marsabit Game Reserve. Rarely found outside northern Kenya, this species wears a sharper, brighter pattern than its more common cousin to the south.

The lion (above), feasting on a choice meal of Cape buffalo, might charge or flee if he saw or sniffed a man, but pays little attention to wheeled vehicles. Guides repeatedly warn visitors to stay inside their cars.

Bounding wildebeests—better known as gnus to crossword puzzlers—belong to an immense herd that crosses and recrosses the Kenya-Tanzania border in search of fresh grass.

And where is Sori? That was the question John D'Souza, an employee of the United States Embassy in Nairobi, and I kept asking as we drove toward Lake Victoria through the land of the Luo and the Kisii and the Kipsigis. Deep viscous pits in roads everywhere hub-deep in mud tried to entrap our four-wheel-drive vehicle. But we pushed on through a fertile, hilly land, so terraced by farmers that one might have thought himself in the Far East. Indeed, it seemed that's where we must be, since no one had heard of Sori.

Celebration Attracts 3,000 Plus Two

Two days out of Nairobi, we found it—the most minuscule of tiny villages, deep in rural Nyanza Province (map, page 156). The new school, yellow as a lemon in its coat of fresh paint, stood atop a bluff overlooking Lake Victoria, a serene sea where little lateen-sail fishing boats moved slowly about like toys on a pond.

I had little time to savor this view. The day's festivities had brought out 3,002 people—an officially estimated 3,000 Africans; one Asian, John D'Souza; and one white man, me. My singularity attracted a throng of curious but well-behaved youngsters who followed me about as if I were some latter-day Pied Piper.

"We don't see many Europeans in here," an official explained. "Only a few since independence."

That day proved to be one of the most memorable and rewarding of my stay in Kenya. No one knew in advance of my coming, but all went out of their way to be kind to the stranger from America.

Hospitality is a way of life to many Africans, and courtesy seems born in them. Villagers often possess manners that would grace an embassy drawing room. Had I met the teachers, the council members, the chiefs? Each smilingly shook my hand. Of course I would sit with the officials during the ceremonies. Would I like a refreshing drink? Miraculously a Coca-Cola appeared. Did I need translators? Someone who spoke Luo and Swahili would be at my elbow always. Would I like to hear the students sing? They would be pleased to do so.

A choral group of boys and girls, immaculate in white blouse or shirt and dark skirt or trousers, launched into a spirited chantlike song, not unmelodic, to the accompaniment of rattles, bells, and sticks tapped together.

"They have been rehearsing this song for the Vice President, who will be here soon to dedicate the school," explained their young principal, Nashon Owino-Were. "The song is about President Kenyatta. They are saying he had to fight to free his country from the British, just as the Americans did."

The school had enrolled 72 students, some from as far as Kisii, 50 miles away; they would board nearby while attending classes.



Finding a place in a secondary school is difficult, even for good students. Ninety-eight percent of the nation's youngsters do not go beyond the seven primary grades.

"Sometimes it takes only a year or two to erect a Harambee school," said Mr. Owino-Were, "but if the community doesn't give good cooperation, it may take as many as five years. This particular school took three."

Vice President Snips a Ribbon

Daniel arap Moi (arap means "son of"), Vice President and Minister of Home Affairs, arrived almost on time despite the mire. A big, youthful-looking man who gives an impression of great physical vitality, the Vice President is a member of the Tugen, a small tribe. Some say he got his job for that reason; he

was not likely to be partial to either of the two largest tribes, the Kikuyu and Luo. However, no one in the government works harder, and he travels Kenya on the same kind of morale-raising missions, and with the same zeal, as President Kenyatta.

Mr. Moi cut a ribbon encircling the school's front porch and then, with an entourage of politicians, moved to the speaking platform. I was pleased when Joseph Odera-Jowi, the local Member of Parliament and Kenya's Minister for East African Affairs, paid generous tribute to a modest United States AID contribution to the school's construction, and I was greatly amused when he introduced John D'Souza as the representative of the United States. Some AID officials had been expected to fly in for the occasion, but the



weather proved too bad—a possibility John and I had anticipated; hence our long drive. Now John, the United States Information Agency's Nairobi photographer and radio specialist, who describes himself as a Goan and a former national of Pakistan who holds a British passport, acknowledged the crowd's warm applause for the United States with a bow of courtly grace.

Tom Mboya, Minister for Economic Planning and Development, and a Luo like most of his audience, spoke so long that he left little time for the Vice President to say much before the onset of darkness. Mr. Moi, however, rose to the occasion with the aplomb of the old pro. He pointed to school children ringing the front of the crowd and asked if their parents liked to see them well dressed,

well behaved, and attending a school function. The crowd roared approval. If children are well educated, they will respect their parents, said Mr. Moi. "Those who do not have an education want to destroy," he added. "They do not want to build."

When darkness fell, someone lit a lantern and the people sang happy songs as they crowded about *their* Vice President, a symbol of the new oneness of the land.

Later that night I sat with the Vice President in the parlor of Mr. Odero-Jowi's nearby home, where the day's luminaries had gathered for a bountiful dinner. Mr. Moi, who had been traveling and speaking since 6:30 a.m. with nothing but a cup of tea to sustain him, took off his shoes and, with a sigh of near bliss, rubbed one stockinged foot over the



FORNHOUS (AP/WIDE WORLD) AND TELEPHOTO © R & S

Stuffed simba "roars" at admirers through the window of Zimmermann's shop in Nairobi. The sight of a life-size lion, even a stuffed one, awes not only tourists but many Africans as well. Many native-born Kenyans living in well-settled areas have never seen a lion, buffalo, or elephant in the wild.

Ivory emporium: A worker hefts a pair of tusks destined for auction at the government's ivory warehouse in Mombasa. Piles of tusks, blurred by the camera's movement, line the warehouse floor. Much of the ivory comes from Uganda; some comes from Kenya game wardens who shoot wounded or rogue elephants and confiscate poachers' booty.



Swollen to one continuous torrent, Fourteen Falls on the Athi River northeast of Nairobi froths with rage after abnormally heavy rains. During the river's more docile moods, 14 separate falls can be counted. Only two of Kenya's many rivers are navigable—and these are



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barely deep enough. The Athi's threshing waters empty into the Galana, where only canoes venture, and nothing bigger than a launch dares the 500-mile Tana, the nation's longest stream. Lacking major inland waterways, Kenya relies on roads and rails to keep its economy rolling.



other. I said something sympathetic, but he smiled and shrugged.

"Except for the rain, this was not a heavy day," said the Vice President. "I was telling our ladies," he added, nodding toward Mrs. Odera-Jowi and several other wives, "that this is the kind of life we lead, and they should not complain. People like to see the government in action; then they are convinced this is not a government that stays at headquarters. If we come to them, they know the policies of the government, and they know we are keeping them informed."

When Mr. Odera-Jowi had asked me to his home, I had accepted the invitation eagerly, as a writer, yet, as a white, or European, I wondered how welcome I would be among the other guests. Only Vice President Moi had met me previously, in Nairobi. Would my presence in such an intimate gathering of political cronies be resented? I should not have questioned the extent of African courtesy; it would have been offensive to our host to betray so much as mild surprise at my presence. So I relaxed and enjoyed the flow of conversation around the crowded room.

Mr. Moi chatted with the area's education officer, praising him so generously that one could see him gaining in self-respect and dedication. "Your work is of the utmost importance, and you are important, because you have the responsibility of future generations," said the Vice President.

Across the lantern-lit room Tom Mboya,



Pedestal of a god

THRUSTING SPIRES SKYWARD, 17,058-foot Mount Kenya (left) crowns the land that bears its name. In all Africa only Tanzania's Mount Kilimanjaro, at 19,340 feet, stands higher. Giant groundsel raise their green rosettes in the Teleki Valley. Spike-leaved lobelia (right), a sample of Mount Kenya's alpine flora, cups limpid rainwater after a downpour.

At the dawn of time, says Kikuyu legend, the Divider of the Universe created Mount Kenya as his dwelling place and bestowed adjacent lands on the Kikuyus. When Europeans claimed these lands early in this century, Kikuyu resentment smoldered, finally flaring into the bloody Mau Mau uprising of the 1950's. Mau Mau terrorists, nearly all Kikuyus, hid from government troops in the sacred mountain's caves (below). Climbers now tread peaceful slopes that rang with gunfire a dozen years ago.



FOREGROUND BY PHILIP SAM, JR. (LEFT) AND BRUCE DALL © N.E.L.



white smile shining like a crescent moon in the dark oval of his face, told a long story about a chief who had opposed KANU—Kenya African National Union—the dominant party and the party of all the politicians present. “Finally the people said, ‘This chief must go. He has a colonial mentality.’” recalled the regime’s political theorist and economist.

Someone told a story about how he had handled a heckler who interrupted a speech, and this started a spate of recollections about political meetings: how to plan them, stage them, keep them under control, address them. It all sounded vaguely familiar, and then I thought: Except for occasional switches from English to Swahili or Luo, these could be the voices of politicians at home in some unguarded bull session.

With regret, John and I finally left, taking with us a carload of guests to drop off at their homes—cones of wattle, mud, and thatch that loomed suddenly in the night. One youth brought his new wife to the car to meet us. A government employee invited us to spend the

night—another unusual opportunity for a European. But John and I had an appointment with an intriguing group of men, the Bomwari Tabaka Stone Carvers, and we drove the rest of the night to keep it.

For many years members of the Kisii tribe have fashioned smoking pipes from the soft white and pink stone of the South Mugirango area. Recently, however, stone carvings of birds and animals, and a few extraordinary busts of people, have found their way to the Nairobi market from a tiny village near the town of Kisii. John and I resolved to find it.

Again rain, again mire, again kidney-rattling jolts and bounces. But finally we reached a Catholic mission of the Mill Hill Order, where a Father Witte, when asked if he knew the carvers, took me into his chapel and showed me a magnificent Negro Madonna.

“A member of this order, Father Herbert L. Doyle, taught sculpture to people in a nearby village; that was about 1930,” Father Witte recalled. “Now it’s a talent handed down from father to son. This Madonna is the work of Alexander, and he’s here.”

So I met a great, if barefoot, artist, Alexander Mogendi, who looked like a leaner and tougher version of the old boxing champion, Archie Moore. With Alexander directing, we slithered for half an hour until we reached a clearing in a small village.

There, under a tree, three men worked, hacking away at pieces of stone with *pangas*, the African version of the machete, or cutting more delicately with knives (page 194). Alexander joined them and went to work on a bust. I marveled at how sculpture of quality could

Two-man gold rush, Kenya’s Kipchoge Keino (front) and Naftali Temu warm up at home before scorching the track at the 1968 Olympics in Mexico City. Keino, a police instructor, outsped U.S. ace Jim Ryun to win the 1,500-meter gold medal. Army private Temu won the 10,000-meter gold medal. Amos Biwoti added to Kenya’s laurels with his triumph in the 3,000-meter steeplechase. In all, Kenya’s team took a remarkable total of three gold, four silver, and two bronze medals. The thin air at 7,350-foot-high Mexico City troubled many athletes, but not the speedsters from Kenya’s highlands—most of whom grew up and trained at altitudes of a mile and higher.

Mock warrior snaps a salute during patriotic festivities at the opening of the hospital in Gatundu (pages 152-3). His cardboard hat bears the colors of Kenya’s national flag.







"Africa distilled . . . the strong and refined essence of a continent," wrote Danish-born author Karen Blixen of her beloved Kenya estate in the 1937 masterpiece *Out of Africa*. Writing under the pen name Isak Dinesen, she chronicled in luminous prose her life on



REINACKER/NT © NATIONAL GEOGRAPHIC SOCIETY

a coffee plantation in the Ngong Hills during the years 1914-31. Today her lands are part of a Nairobi suburb named Karen in her honor. Here the westering sun flings long shadows across fields she described as "bright-green in the grey-green land."



SCULPTORSHIP BY ELLAN L. FISHER, OF THE U.S.S.R.

With a gentle whack, a soapstone sculptor of the Kisi tribe, watched by his son, roughs out a figurine with a machete-like *panga*. He will use a smaller knife to carve details. Taught sculpture by a Catholic missionary in the 1930's, members of his village hand down the art from father to son.

emerge under hands wielding such crude tools.

When we left, several of Alexander's finest busts and a number of works by others, all carefully wrapped and tenderly cradled, rode on the back seat. But I felt a bit guilty; I had bought the lot—beautiful objects I shall always treasure—for the equivalent of only \$32, the asking price.

Rural Kenyans Seek Better Life

Kenya's average European visitor never meets an African socially. He is led about by his own kind, travels with his own kind. People he sees in rural areas obviously possess few of this world's goods, and he concludes that, by and large, they are a primitive lot.

I disagree. So does Donald F. Helsel, a research sociologist of the Population Council, located in New York City, and a staff member of the Institute for Development Studies of University College, Nairobi.

"I can't think of any word less appropriate than primitive," he told me. "I find people in the rural areas acutely conscious of what affects them. They are a very intelligent people, by no means cut off from the world. There is a tremendous eagerness for improvement, a real attempt to pull themselves up by their bootstraps. They are trying to hammer out a new style of life; the movement is likely to be toward the kind of urban economic development we know.

"At the same time, there is real poverty and real desperation in some areas. If their aspirations are not fulfilled to a degree, there will be bitterness and a search for a scapegoat."

These comments apply principally to what might be termed the awakened tribes, the tribes of Kenya's breadbasket, who have advanced cultures of their own and who have had the most exposure to the white man's ways. In its wilderness areas, Kenya still has truly primitive peoples, such as the Masai, the Turkana, and the Somalis.

Ah, the Masai *morán*, or warrior! Tall, proud, ready to kill a lion with his spear, drinker of

a stern concoction of cow's milk and cow's blood (page 155).*

Yes, this storied Masai still exists, but you should see the way he lives—in a squat, tunnel-like hut of brush plastered with cow dung, huddled with other huts and the village herds of cattle and goats, behind a protective circle of thorn brush. Periodically, when the nearby forage gets low and even the Masai can't stand the smell and the flies of their village, they move to a new site.

Out in the bush I have encountered Masai herdsmen whose stoic disregard of hardship and danger compelled my admiration. But I have also seen Masai beg money from tourists, with harsh cries of "*shillingi! shillingi!*" in return for posing for a photograph. I once watched a tourist with a movie camera pay villagers to form a circle, join hands, and jump

*See "Spearing Lions With Africa's Masai," by Edgar Monsanto Queeny, *GEOGRAPHIC*, October 1954.

up and down with wild yells—the tourist's idea of a Masai dance. The Masai laughed, but I couldn't.

Masai are a proud people trying to cling to old ways in a world that won't let them. The government worries about this, particularly the demeaning effect of the tourists, but unlike Tanzania, which makes Masai warriors wear pants when they come to town, Kenya will not force change upon the tribe. Mara and Amboseli reserves, plus a number of shooting blocks, lie in Masai lands; so the tribesmen get substantial sums from entrance and hunting fees and lodge revenues. The government encourages them to spend the money on education and such village improvements as water development and health centers.

Until recently the government had only the most nominal and precarious hold on two large areas: in the north, homeland of the Turkana and several smaller tribes, and in the northeast, inhabited by the fierce, nomadic Somalis. For years *shifta*, or bandits, incited and armed in neighboring Somalia, pillaged and killed in both areas—often referred to simply as the "northern frontier." In 1967, however, Somalia and Kenya signed a "memorandum of understanding," ending, temporarily at least, a secessionist move by Kenya's Somalis, and things have been better since then.

Just the same, you still need special permits to go into either of the two regions, and you must charter a plane to fly in and out; *shifta* planted land mines under numerous roads, with occasional lethal results to Kenya police and

troops. Many tourists fly to Samburu and Marsabit reserves, both quite safe, but few venture anywhere else in those vast arid expanses, mostly desert terrain of a harshness unimaginable to people from gentler lands.

However, after some delay Bruce Dale and I obtained permits for forays into several remote locales—definitely "the back of the beyond," as the British might say. We had heard of a colorful chap, H. W. (Tim) Durrad, a farmer who for years had vacationed with his family on Lake Rudolf, apparently unconcerned about either the Turkana or the *shifta*, and who had just opened a fishing camp on



Deadly harvest: Jonathan Leakey, son of anthropologist Louis S. B. Leakey, measures dehydrated venom of Jameson's mambas for shipment from his Kenya snake farm to an antivenin producer. Helpers must handle the snakes; herpetologist Leakey is allergic to the antivenin, so he risks death if bitten. A cool-nerved Turkana tribesman (lower) "milks" a green mamba.





Probing prehistory

KENYA HARBORS in its soil some of the oldest hominid fossils ever found, and may have been the birthplace or early childhood home of man himself. For nearly a decade, the National Geographic Society has sponsored Dr. Louis S. B. Leakey's dramatic researches into the African ancestry of animals and man. Aided by his wife Mary and their three sons, the Kenya-born scientist made, at Olduvai Gorge, Tanzania, the epochal discoveries of two early manlike creatures—*Zinjanthropus*, 1,750,000 years old, and *Homo habilis*, nearly 2,000,000 years old. Sites now being probed in Kenya, he believes, may yield equally significant results.

Dr. Leakey's son and daughter-in-law, Richard and Margaret, dig out remains of a prehistoric human skull (left) from a site at Allia Bay on the eastern shore of Lake Rudolf.



DETACHMENT SLITTL AND RODACINOMAS BY ROBERT M. CAMPBELL © N.G.S.

Surprise discovery of fossil antlers, found at Fort Ternan in 1965, provided the first evidence that antlered animals resembling deer—as opposed to horned antelope—once roamed Africa south of the Sahara. The Fort Ternan dig, in western Kenya between the Rift and Lake Victoria, has yielded a wealth of fossils dating from 14 million years ago. Among the finds: a stone that was used as a hammer and some bones that clearly had been broken up by man's early ancestor *Kenyanthropus wickeri*.

Intact after three million years, the fossilized skeleton of an extinct elephant emerges from its ancient resting place near Lake Baringo. Under the meticulous supervision of Richard and Margaret Leakey, the huge fossil was excavated with its surrounding rock and transported in one piece to the National Museum in Nairobi, where it is now exhibited. Though a true elephant, it was of a species distinct from both the African and the Indian elephants living today.



the remote lake. So we chartered a plane and flew up to Tim's place, a surprisingly comfortable little group of cottages on a high sandspit jutting from the western side of the large, rather brackish lake.

Tim, who had obtained from the government a sport-fishing concession for the area, tried his best to entice Nile perch onto our hooks. No luck. A severe storm, the worst in the memory of even the Turkana, had hit Rudolf the day before our arrival, tearing away 10 feet of cliff in front of the camp and ruining the fishing for a time. From visions of a huge fish—the lake record for a Nile perch is 238 pounds—my thoughts turned to Turkana and shifta.

I had heard that the Turkana, even today, practice occasional cannibalism. Tim was noncommittal, but he did say thoughtfully:

"The Africans from my farm don't like to come up here; only one of them will stay here alone—and come to think of it, he ran off the other day. As for the shifta, no trouble for some time, but about three years ago they killed the European manager and another bloke at a fishing camp on the other side of the lake."

Often we saw Turkana fishermen, thin as marsh reeds and naked as eels, standing on the prows of their wobbly, pirogue-shaped boats, somehow tending nets without toppling into the water. They would wave, like

Dwellers in a desolate Eden

THE PRIMITIVE TURKANA of northwest Kenya migrated some 200 years ago from Uganda and Ethiopia to the area between Lake Rudolf and the Uganda border. Their legends tell of a lush, fertile land that existed here, but lack of water has turned their garden—if it ever existed—into a semidesert.

Lake Rudolf's fish are one of the region's few remaining bounties. The Turkana woman at right carries a respectable catch, pancake-fashion, on her head. Huge Nile perch weighing 200 pounds or more lurk in Lake Rudolf's depths; the species survives from a time more than 100,000 years ago when the lake had a direct link with the Nile.

A boatman (left) propels his craft of spongy umbatch wood across Lake Rudolf. With a mere bladeless stick for an oar, he moves along at surprising speed.

Many Turkana eschew lakeside life and wander with their herds of cattle, camels, goats, and sheep through the sun-shriveled lands west and south of Lake Rudolf. Their age-old custom of rustling cattle from other tribes has won them an unenviable but well-deserved notoriety.

friendly boatmen everywhere. In a village of woebegone little huts ashore, Turkana proved just as friendly—and nearly as naked—but most seemed to fear cameras.

I made one friend, perhaps a chief, since he wore a blanket and a beaded cap. He proudly read to me the letter "Y" from the side of our airplane, and I tried to teach him other letters of the alphabet. His pronunciation improved markedly, but not his memory. Yet intelligence and interest flickered in those bloodshot eyes, waiting for someone with enough time and patience to unlock for him the mystery of print.

On another flight Bruce and I reached Wajir and El Wak, two desert outposts that look



HEADBAND: JAGREI AND DETACHMENT BY BRUCE DALE © K.G.Z.

like Hollywood sets for a film about the old French Foreign Legion. And, in the best Hollywood tradition, armed soldiers met our plane at Wajir, gave us strict orders not to photograph the town or "government buildings," and dispatched us through streets of squat whitewashed houses—one of them pockmarked by shifita bullets—to the office of District Commissioner M. M. Muhashamy.

He proved friendly and, though apparently uneasy at some of my questions, he made light of the shifita problem.

"Since the agreement between Kenya and Somalia, things have really slowed down," said the D.C. "The main problem now is tribal clashes because of the theft of animals."



Pungent with the past, Mombasa's Old Town smacks of the Middle East more than of sub-Saharan Africa. Arab trading dhows in the Old Harbour await seasonal winds that will carry them—laden with coffee, ivory, skins, and other cargo—back to home ports as far



REUTERS/CL. WILSON/REUTERS/CL. WILSON

away as the Persian Gulf and India. But Mombasa has not escaped modernity. On the other side of this island-city, sleek ocean liners and stout freighters bustle in and out of Kilindini Harbour, a major depot for goods funneling to and from Kenya and Uganda.

Even so, tight security gripped us. We saw the wells where Somalis—a Moslem people whose women, fine-featured and often beautiful, go unveiled—watered their herds of goats and fat-tailed sheep, but we didn't see inside the fort. And we saw the handsome new secondary school, the only one in all North Eastern Province, and a new village of sturdy, substantial huts built in Kikuyu style as examples for the Somalis, who normally live in much cruder dwellings. The government in distant Nairobi was doing its best for the Somalis—but it was keeping a tight rein on us.

Death in the Desert: One Yacht Club

Everyone seemed relieved when we paid a lighthearted visit to the moldering headquarters of the old Royal Wajir Yacht Club, now defunct but once the lively, if waggish, creation of a former British District Commissioner. He thought it would be splendid to have a yacht club in the middle of the African desert, and he built a small headquarters with a nautical flagstaff. Visitors surrendered their hats, which became wall decorations, and in return

were given the Royal Wajir Yacht Club tie.

I told the commissioner that, as a sailor, I was saddened to see the passing of a yacht club. He solemnly assured me that he had plans to revive it as the Wajir Ngamia Club. In Swahili, *ngamia* means "camel"—ship of the desert. On the spot he conferred honorary membership upon Bruce Dale and me.

Security proved equally tight at El Wak, less than five miles from the Somali border. Again armed soldiers met us, and again restrictions hampered our photography. This was particularly disappointing because El Wak has a wonderfully photogenic old fort that looks as though Beau Geste should be peering down, steely-eyed and resolute, from the high walls. But we were permitted to see the interior, on our word of honor not to sneak pictures.

Outside the walls the remains of trucks blown up by land mines and brought to the fort for salvage had been gathered in a rusting pile. When we took off from the airstrip, an armed guard stood along the perimeter, eyes searching the rocky desert.





PHOTOGRAPH BY ROBERT BALE © R.O.B.

Sindbad slept here, says local legend of the island town of Lamu on Kenya's drowsy Indian Ocean coast. Arab ivory and slave traders rode the monsoon winds to these shores and founded settlements that still exude an Arabian Nights atmosphere. The 20th century has barely set foot here; even bicycles are unknown. As dusk falls, a lamplighter ignites lanterns to guide the fishing fleet back to port.



Grisly relic, thought to be the centuries-old skull of a Portuguese, grins from a niche in a Lamu residence. The Portuguese held a maritime grip on Kenya's coast from the early 1500's until 1729, when the Arabs ousted them.

Goggled visitor joins a school of damselfish in the Malindi Marine National Park, an underwater sanctuary established in 1968 along the coral coastline south of Malindi.

A kaleidoscope of natural and man-made entertainment awaits vacationists to this coastal playground of Kenya, where game fishing, coral gardens, sun-blessed beaches, chic resorts, ancient ruins, Arab bazars, and game-filled bushlands all lie within easy reach.





These precautions didn't seem so melodramatic when, flying out, we passed over the ruined village of Benane, wiped out by shifta to the last man, woman, and child 18 months earlier. And we felt downright grateful for the government's concern about us when, 10 days after our visit, shifta struck a village near Wajir, killing several residents, and planted a land mine that blew up some of the men who had protected us.

In the main, the peace agreement works—but with grim lapses.

This occasional guerrilla warfare, however, need not concern visitors to Kenya. The parched and isolated frontier districts long have been a world apart from the rest of the country. Indeed, so highly varied is Kenya's terrain that it can be said to encompass numerous worlds, one of the most surprising being the resort-studded seashore, a bit of Florida transplanted to old Africa—but without the high prices.

From just south of Mombasa, Kenya's modern port and second largest city, to the coastal town of Malindi, a favorite watering spot of West Germans, you can take your pick of accommodations ranging from comfortable to luxurious. I particularly enjoyed the Mnarani Club at Kilifi and the Dolphin, near Mombasa.

Decrepit Launch Serves Idyllic Isle

My favorite spot, however, lies far off the tourist track and is little known, very small, and difficult to reach: the Peponi Hotel on the island of Lamu off Kenya's northern coast. In Swahili, *peponi* means "the place of coolness, rest, and relief from trouble"—Paradise, to put it simply. And that's just what it is, a heavenly little refuge beautifully run by a Dane and his German wife. The island, which boasts but one automobile, can be reached by a combination of shattering bus ride and fishing boat-taxi. But this is a difficult and chancy business, and nearly all visitors fly by chartered plane to an airstrip near Lamu, as I did, and then board a decrepit launch for the trip to the hotel at the mouth of Lamu Harbour.

Lamu town is one of the oldest on the east African coast, just how old no one knows.

Arabs came to these shores after the death of the Prophet Mohammed in A.D. 632, when disputes over a successor wracked Arab lands. Lamu remains Arab, a town of great charm, of ancient buildings and carved doors and narrow streets where even the bicycle is unknown. At twilight a lamplighter touches off oil lanterns that flare along the quay and light the return of the fishing fleet (page 203).

Kenya's coast abounds in ancient Arab ruins, but the only ones that have been cleared of bush for public access are those at Gedi, a town founded in the 13th century and now a national park. Compared to Gedi's ghost-haunted remnants, Mombasa's well-preserved Fort Jesus, built by the Portuguese at the end of the 16th century, seems a contemporary upstart. Except for Fort Jesus, practically nothing remains of a Portuguese coastal occupancy that endured for two centuries.

Room Enough for Old and New

When we flew from Lamu, our pilot circled some virtually inaccessible Arab ruins. No one knew much about those crumbling coral walls; they may have housed old rivals of Lamu, a people whose story the slow centuries erased.

As we droned down the coast toward Malindi, I scanned the gray brush of dunes running back from the sea, idly wondering if I would spot more ruins and musing about the transitory imprint of man.

Then I saw him—an old bull elephant, massive of tusk, ambling in solitary contentment through the hot sands and the thorns toward the sea. He might have been living when the first train pulled out of Mombasa for Lake Victoria, opening up his land to the tide of white immigration now so obviously on the ebb. Whatever changes white men had brought to Kenya, they had not affected this lordly bull, symbol of that amazingly fecund animal life, born free and living free.

Would it always be that way? I hoped so. When the lord Mogai fashioned Kenya, he must have done so with special love and care to make it so beautiful, and he gave it enough space for both the old Kenya and the new.

THE END

Beating out a rhythm on an empty gasoline can, a young Kenyan scares grain-gobbling birds off his family's rice field in the Mweni Irrigation Settlement. Here, where Mau Mau prisoners worked sullenly at forced labor in the 1950's, some 1,000 African families now tend their own land in a labor of love. Looking to the future, Kenya's people see a vista of hard work, cooperation, and ever-increasing pride and prosperity.



That orbèd maiden, with white fire laden, whom mortals call the Moon

By KENNETH F. WEAVER

Assistant Editor

GODDESS OF THE NIGHT they called her: Selene, Artemis, Cynthia, Luna. Men worshiped and feared her, believing that her mystical powers influenced life on earth. They closely marked her inconstant face, measured time by her waxing and waning. They sang of her splendor, named her "bright wanderer," "fair coquette of heaven," "sweet regent of the sky," "Mother Moon."

Once she was unreachably remote—the province of poets, of shepherds and nomads, of lonely astronomers and not-so-lonely lovers.

Today, in the twelfth year of the Space Age, earth's natural satellite has become the concern of everyman, and the object of the most intensive scientific and technological effort in history. Hundreds of thousands of people, and industrial firms by the thousands, have turned their energies toward realizing the goal of putting men on the moon.

Man has already probed at the moon with some 45 spacecraft bearing names

like Luna and Zond, Ranger, Surveyor, and Orbiter. From afar we have poked and scratched its surface, hammered on its rocks, assayed its chemistry, measured its temperatures. We have tested it with radio waves, the exhaust of rocket engines, and magnets. We have photographed from close up all but the merest smidgen of its tortured face. (See the eight-color wall map, *The Earth's Moon*, a special supplement to this issue.)

And now, as this is written, a few chosen men, astronauts and cosmonauts, train with monastic zeal for the fantastic attempt that will bring alive the tales of Jules Verne and H. G. Wells.

Before long we may have at least partial answers to riddles that have always haunted men: Where did the moon come from? Of what is it made? Is it really cold and dead? And does life exist there? The moon may even prove to be the Rosetta stone of the solar system, the key that will help us understand the early history of the earth and her sister planets.

Late, late yestreen
I saw the new moone,
Wi' the auld moone
in hir arme, And I feir,
I feir, my deir master,
That we will cum to
harme.

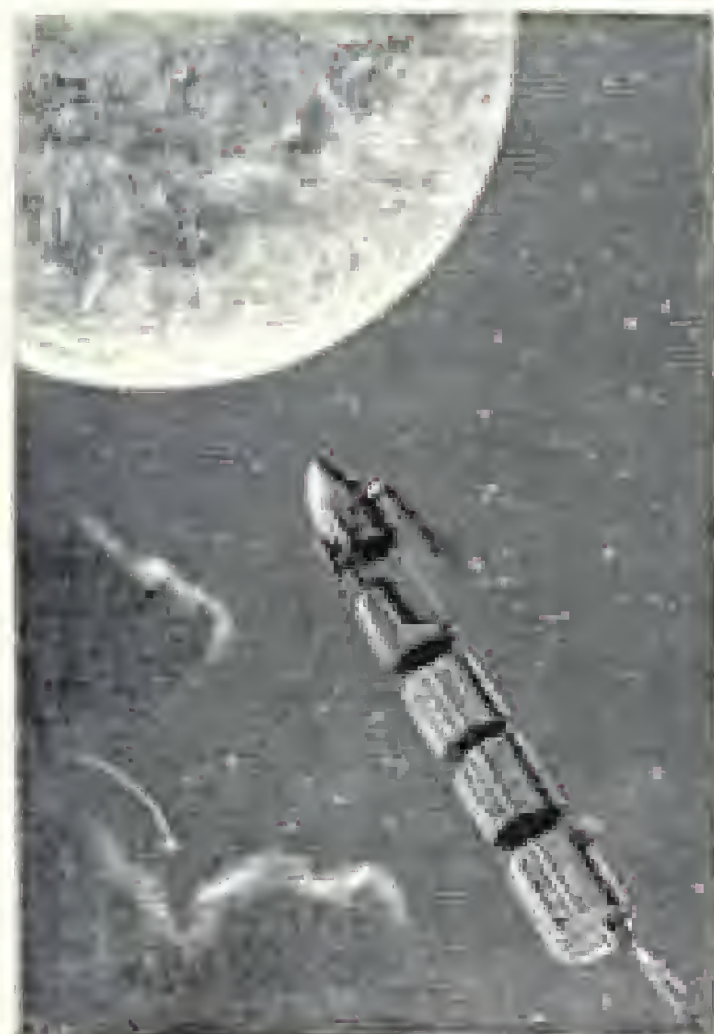
"BALLAD OF SIR PATRICK SPENS"

The moon has inspired more superstition than any other celestial body. It has long been regarded with foreboding, as an omen of evil, especially when it eclipses the sun, or when its dark orb, faintly lit by earthshine, lies cradled in a silver crescent.



And even the full moon has held its terrors. From the remotest times it has been supposed that sleeping in full moonlight can cause blindness or madness. The very word "lunatic" derives from the Latin for moon.

Some farmers to this day believe that the moon affects the weather, and that crops should be planted according to the moon's phases. "Sowe peasen and beans in the wane



Early portraits of earth's heavenly companion bear names that still survive. In 1647 Johannes Hevelius, on the first true moon map, called the dark areas *maria* (plural of the Latin *mare*, sea), reflecting a belief that these vast plains were water. Four years later Giovanni Riccioli renamed the maria and christened craters for famous men, as is still done. Their pioneering work still found currency in the early 1700's, when J. G. Doppelmayr of Nürnberg, Germany, published this re-rendering of the Hevelius (left, above) and Riccioli maps.

Moon express, a coal-burning train speeds toward its destination. Though illustrating Jules Verne's 1865 classic, *From the Earth to the Moon*, it bears little relation to the cannon-shell spacecraft in the French author's text. Amazingly prophetic, he described a three-man lunar capsule blasted into space by a giant gun near Tampa, Florida—only 120 miles west of today's Cape Kennedy.

of the moone; Who soweth them sooner, he soweth too soone," goes the old saw.

Could the moon, with all its supposed influences on earthly life, have inhabitants of its own? Johannes Kepler, famed German astronomer of the early 17th century, thought so. He believed that the craters on the moon were artificial—that they had been made by whatever creatures lived there. And in 1835, a front-page story in the *New York Sun* told in detail how Sir John Herschel, son of Britain's Court Astronomer, had built a monstrous telescope 24 feet in diameter, and how he had seen through it lunarian men with wings like bats. An excited public learned later that it was all a journalist's hoax.

But less than a century ago, William H. Pickering, the respected American selenographer, saw with his telescope variable spots in certain of the moon's craters that seemed to darken after the beginning of the lunar day and then wane just before the sun set, 14 earth days later. He speculated that these could be some low form of vegetation. He even thought he saw melting snow that could have provided water.

Once I asked Dr. Eugene Shoemaker, then head of the Center of Astrogeology of the U. S. Geological Survey and one of the major experimenters in the Surveyor program (page 213), if there is the remotest chance of finding life on the moon. He burst out laughing.

"Well, of course there are the lunar elephants! We'll see those!" he said.

He referred to a pompous 17th-century Englishman, Sir Paul Neal, who announced that he had discovered an elephant on the moon. The announcement created a tremendous stir until—according to the story—people found that all he had seen was a mouse that had crept into his telescope.

Dr. Shoemaker added that "the moon is the kind of place where you would put things to sterilize them." Lacking atmosphere, it feels the full brunt of solar radiation, including deadly ultraviolet, X-rays, and gamma rays. No surface water exists to sustain life—on that scientists agree. Midday temperatures at the equator are hotter than boiling water; with the coming of the lunar night they plummet some 500° F. And the moon exists in an almost total vacuum (although it must be noted that some earthly spores have proved able to survive without oxygen or atmospheric pressure). So it is not hard to accept Dr. Shoemaker's estimate that the chances of native life—even microscopic life—are no better than one in ten billion.

We may not be able to detect such life even if it is there. As Dr. Wilmot Hess, Director of Science at the Manned Spacecraft Center in Houston, points out, "The suit worn by the Apollo astronauts leaks at the rate of roughly 1,000 micro-organisms a minute. So biological analysis of the moon becomes difficult. How do you separate your bugs from moon bugs?"

But the National Aeronautics and Space Administration is taking no chances. When our astronauts return from their first moon landing, they and the samples they bring back will go into quarantine in special quarters in Houston—the astronauts for 21 days; the samples for a month or more. Even the Apollo Command Module, in which the astronauts have traveled home again, will be sealed in this Lunar Receiving Laboratory until experts are satisfied that no harmful lunar material exists to escape on earth.

The bent and broken
moon, All batter'd,
black, as from a
thousand battles . . .

JOAQUIN MILLER, "INA"

People once thought that the surface of the moon was smooth and crystalline, that like a mirror it reflected the continents and seas of earth.

Since Galileo's time, at least, we have known otherwise: The 14,650,000 square miles of moon are incredibly rough, a cosmic battlefield. Even a small telescope brings to view the startling, awesome moonscape which Galileo was first privileged to see, and which must have thrilled him beyond measure. It is a scene of unearthly wildness, of forbidding badlands, of desolate dark plains, of harsh shadows, set off by a sky of utter blackness.

The dusky regions, given the Latin name *maria* because 17th-century astronomers thought they were seas, form the whimsical figures that men of every age have fancied. There's the man in the moon, with Mare Imbrium as his right eye, Mare Serenitatis and Mare Tranquillitatis as his left eye, and

(Continued on page 214)





PHOTOGRAPH (LEFT) BY LUNAR ORBITER 4; MARE, PAINTING BY HARRY BELLEFON © R.S.G.

Cataclysm shapes a ravaged face: a four-stage re-creation of the possible genesis of Mare Imbrium, largest of the moon's circular "seas." Striking with the energy of millions of H-bombs, a massive comet nucleus or an asteroid splashes molten rock and debris across the moon and into space. Two vast basins form: a central crater from the impact, and an encircling depression caused by gradual slumping. Later, lava wells from a molten interior—time and again. Finally, perhaps 500 million years after impact, Imbrium's lava sea lies cold and pitted by meteorites, a stage shown also by huge Mare Orientale (left). The craters indicate how two forces—impact and volcanism—are believed to have molded the moon's features.

Colossal bull's-eye, Mare Orientale sits in a series of rings 600 miles across, with 15,000-foot peaks. At upper right spreads dark Oceanus Procellarum, right temple of the "man in the moon."



DONALD E. GAULT, right, and **William L. Quaide**, experts on craters, adjust rods that register contours of a man-made crater at NASA's Ames Research Center near San Francisco. An aeronautical engineer, Mr. Gault has developed a gun that hurls projectiles up to 28,000 feet a second to simulate meteorites, aiding study of crater formation.

PHOTOGRAPH BY JAMES L. STARBUCK (LEFT) AND JAMES L. STARBUCK (RIGHT) (LOWER LEFT) BY JACK FIELDS (U.S.C.)



HAROLD MASURSKY analyzes a moon-scape photographed by one of NASA's five Lunar Orbiter spacecraft, whose cameras surveyed potential landing spots for Apollo astronauts. Chief of the Branch of Astrogeologic Studies of the U. S. Geological Survey in Flagstaff, Arizona, Mr. Masursky headed the team responsible for interpreting the Orbiter pictures.



Moon men

GERARD P. KUIPER, left, a renowned astronomer who still keeps an eye to the telescope, heads the Lunar and Planetary Laboratory at the University of Arizona in Tucson. He was among the first to believe that the lunar surface would reveal a soil chemically similar to earth's basalt—a view confirmed by U. S. spacecraft. Here he stands before a telescope with two colleagues, Ewen Whitaker, a specialist in analysis of moon photographs, and Robert Strom, who has mapped the satellite's fracture lines.

CLOSE, CLOSER, CLOSEST: Three pictures show the Crater Alphonsus from the Ranger 9 spacecraft hurtling moonward....



258 MILES from the moon, Ranger televised this scene to earth, March 24, 1965.



42 MILES to go: Furrows called rilles appear clearly; tiny craters now grow large.



4 1/2 MILES away—3 seconds before crashing. Circle on pictures marks impact point.

Mare Humorum and Mare Nubium as his mouth. Orientals imagine a long-eared rabbit, or a monkey pounding rice. Others see a lady (see insets on supplement map).

These dark seas appear to be smooth and level, as though water did indeed lap their shores. Actually, most scientists believe that lava or volcanic ash filled them long ago (page 211). Oddly, there are few large basins on the far side of the moon, and those that do exist often lack the dark filling that makes the near-side maria so noticeable.

The bright, silvery regions of the moon which shine so intensely are mountainous. These jumbled highlands cover 60 percent of the face we see and virtually all the far side, which man knows only from Luna, Zond, and Orbiter photographs.

Long mountain chains, bearing such names as Apennines and Alps, separate the maria. They rise as much as 20,000 feet. To men on the moon, however, they may not seem that high—or be visible at all. The surface of the moon, only a fourth the diameter of earth, curves so rapidly that the horizon, to a six-foot man, will be only about a mile and a half away. On earth it is twice as far. To an astronaut on foot, the moon will appear for the most part flat or gently undulating, with all but nearby peaks hidden below the horizon.

The lunar seas and uplands dominate the naked-eye view of the moon, but in the magnificent photographs snapped by spacecraft, nothing catches the eye like the mad profusion of craters. Thousands upon thousands of these symmetrical pockmarks saturate every square mile of the moon, from colossal basins like Bailly, 18.5 miles across, down to tiny cups less than an inch in diameter.

Even the maria floors, which seemed so smooth in photographs from earth, are riddled—more, actually, than the highlands. On the front side alone, one can count a third of a million craters that measure more than a mile across, and they in turn are peppered with countless smaller ones.

So numerous are the craters that they often overlap. The older a feature is, the more craters have pocked and altered its surface.

By and large the craters have rims, and some have central peaks or terraces (top left and page 234). Some are more than three miles deep, some are shallow, and some are ghosts, apparently all but drowned in lava.

One small depression bears the name Hell—a seemingly apt description for its Dantesque setting; in reality it was named for an

18th-century Jesuit astronomer, Maximilian Hell of Vienna.

When the moon is full, another feature becomes strikingly visible—the enormous system of bright rays flaring in all directions from several of the youngest and most prominent craters: Copernicus, Kepler, and—most notably—54-mile-wide Tycho, whose rays can be seen with the naked eye (page 235).

The rays seem to be ejecta—debris sprayed from a crater at the time of its formation, like milk splashed out of a pan when a ball is thrown forcefully into it—and scars opened up by the ejecta. Probably, say most scientists, these large craters were created by the impacts of comet nuclei or asteroids.

The object that blasted out Tycho is estimated to have been at least two miles in diameter. So violent was the impact that “the moon must have shaken like a bowl full of jelly,” to quote Harold Masursky of the U. S. Geological Survey, one of the principal interpreters of the Lunar Orbiter photographs (page 212).

Some of Tycho’s rays reach more than 1,000 miles. Because there is no air resistance, because the surface gravity is low (1/6th that of earth), and because of the sharp curvature of the moon, ejected material travels up to ten times as far on the moon as it would on earth.

Less prominent and far more puzzling are the sinuous rilles, strange narrow channels or valleys that meander like rivers for as much as 200 miles (page 237). Scientists are truly perplexed by these features. They seem to originate in craters, and some specialists think they were carved by lava or ash flows. To others they suggest underground lava or water channels that have collapsed or subsided.

And a few say that only surface water could have cut such distinct, wandering channels. Many observers suspect that the moon holds large quantities of water in the form of permafrost extending deep under the insulating surface layer.

If the water rises to the surface, however, it is difficult to explain satisfactorily what prevents its swift disappearance by evaporation in the moon’s intense vacuum. Possibly this sudden evaporation cools the near-surface water so much that it freezes into a protective layer of ice and mud. Beneath this temporary shield, flowing water might gradually etch a rille. In all cases the rilles simply peter out; none shows a delta such as would characterize a similar stream on earth.

Sinuous rilles are comparatively rare; only fifty or so are known. A more common and much different kind of channel, called linear

rille, goes in a relatively straight line instead of meandering. Linear rilles represent tension cracks or faults in the crust. More than a thousand of them have been catalogued.

Occasional low domes add variety to the lunar surface, especially in the region known as the Marius Hills, near the crater Marius (4H on the map). As much as 6 miles across and 1,000 feet high, they resemble low volcanic domes on earth. They provide significant evidence that at least part of the moon’s formations are volcanic (page 220).

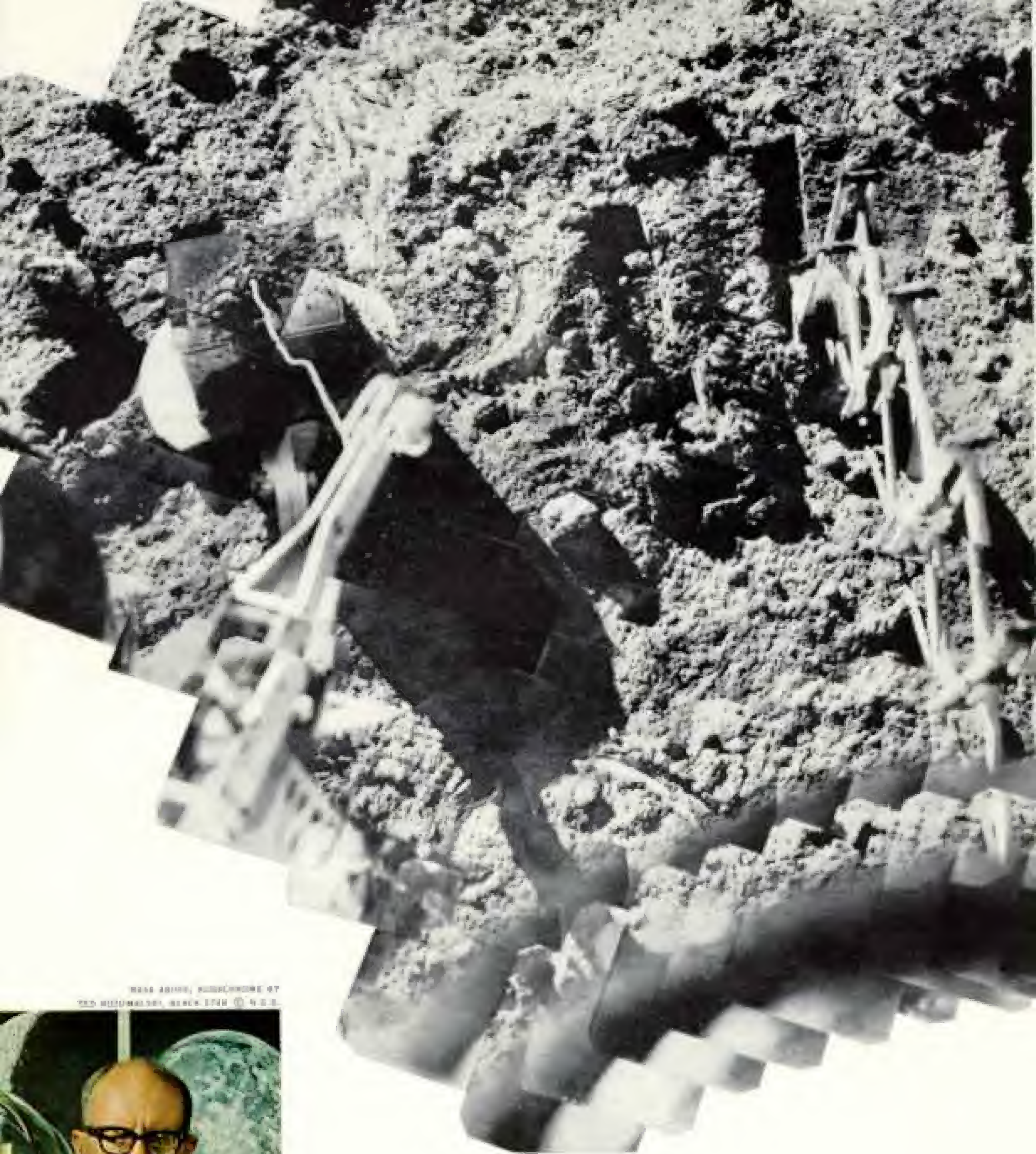
Approximately 5,000 markings on the battered face of the moon have been given names by the International Astronomical Union, which must approve all lunar nomenclature. Only a handful of the myriad formations on the back side have yet been officially tagged, and these bear names suggested by the Russians, whose Luna 3 first photographed that side in 1959.

He made an
Instrument to know
If the Moon shine at
full or no . . .
And prove that she
is not made
of Green Cheese.

SAMUEL BUTLER,
“HUDIBRAS”

As I write these words, the full moon has just risen above the buildings across the way. From my office window I can view the black-and-silver face in all its glory. I am intrigued by the thought that, although I cannot see them, some very special and expensive instruments designed by man lie at 23 different sites scattered across that glittering moonscape. For that is the number of spacecraft—17 U. S. and 6 Soviet—that have crashed or soft-landed on the moon as of this autumn night.

With the best of earthbound telescopes (and the best are very good indeed), lunar photographs have been able to show nothing smaller than 800 feet across. That is roughly



MOON ABOVE, MUSEUMBORE BY
TED HILTON/ALDO, BENCH STAN © N.S.B.



“Surveyor 7’s battleground”

Thus moon men label this 50-square-foot plot of lunar highland. Here, near the crater Tycho, the final craft of NASA’s successful Surveyor series soft-landed a year ago, scouting the lunar surface.

Monitoring through Surveyor’s television eye, whose photographs form the chips of this mosaic, scientists on earth dramatically utilized the robot’s two movable sensing tools: an extensible digger called a soil mechanics surface sampler, visible at center, and a chemical analyzer called an alpha



back-scatterer, held by a jointed arm at left. A model of the scatterer (left) rests before one of its designers, Professor Anthony L. Turkevich of the University of Chicago.

On orders pulsing from earth, the alpha device went into action. Lowered to the lunar surface, it bombarded the soil with atomic alpha particles and measured the energy of their rebound. A weak bounce indicates light elements; a strong bounce, the presence of heavy elements such as iron. Analyzing the rebounds later, scientists concluded that much of the moon stuff must be chemically similar

to earth's most abundant volcanic rock, basalt.

Next the digger probed, jerkily gouging trenches whose sharp edges bespeak a slightly cohesive soil. Its scoop picked up a rounded stone near the scatterer, weighed it, then fumbled it. Twice the digger clawed futilely for a large rock just out of reach, upper center. Poising above another, at the end of the trench at far right, it slammed down and chipped off a fragment, determining the strength of lunar rock. Magnets on its scoop picked up grains and bits of moon matter, more evidence of iron-rich minerals.

Obedient robot, a test model of Surveyor 7 crouches behind Professor Ronald F. Scott at the Jet Propulsion Laboratory in Pasadena. Responsible for the spacecraft's digger, Dr. Scott saw the mechanical arm function almost flawlessly on Surveyors 3 and 7. Its testing of the moon's soil gave data that have helped fix the size and shape of footpads for the Lunar Module landing craft.

Because liquids quickly evaporate in the lunar vacuum, the digger was designed with joints that require no lubrication. Three tiny motors move the accordionlike arm sideways, vertically, and in and out, while a fourth works the hand-size scoop at the end.

Here Surveyor also lowers its alpha scattering device, to the right of the digger. The central mast holds a steely-blue solar panel used to convert sunlight to electricity. Just below it hangs a cylindrical TV camera, man's first eye on the moon.



ROSCOPHOTO © R.M.S.

the same as looking at the moon from about 400 miles away. A much closer look was necessary to scout suitable landing spots for Apollo astronauts.

So seven Rangers were sent up to transmit television pictures as they plummeted toward crash landings on selected flat regions near the lunar equator. The last three succeeded spectacularly, in 1964 and 1965, sending back thousands of detailed scenes of Mare Cognitum, Mare Tranquillitatis, and the crater Alphonsus (page 214). Mare Cognitum, the Known Sea, or the "Sea That Has Become Known," received its name in honor of the first close-up photographs, taken by Ranger 7.⁹

Ranger increased a thousandfold our ability to see detail. But the Apollo planners needed more. They needed actually to test the surface, to assure that astronauts and spacecraft would not be swallowed up, as some people feared, in a deep, treacherous sea of dust.

Five successful Surveyors, out of seven attempts in 1966, '67, and '68, soft-landed on the moon and gave unequivocal answers.[†] Their TV cameras were able to see particles as small as a fiftieth of an inch. But more

⁹See "The Moon Close Up," by Eugene M. Shoemaker, NATIONAL GEOGRAPHIC, November 1964.

[†]This historic project was described in "Surveyor: Candid Camera on the Moon," by Homer E. Newell, NATIONAL GEOGRAPHIC, October 1966.

important, as each spindly, spraddle-legged craft dropped gingerly to the surface, its speed largely negated by retrorockets; its three footpads sank no more than an inch or two into the soft lunar soil. The bearing strength of the surface measured as much as 5 to 10 pounds per square inch, ample for either astronaut or landing spacecraft.

"It will be like treading on old snow with a set of oversize galoshes," says Gene Shoemaker. A man will sink enough to leave footprints, but he will be able to walk without a great deal of trouble.

Two of the Surveyors carried a soil mechanics surface sampler—a clamshell digger on the end of an extensible lazy tongs. At the Jet Propulsion Laboratory in Pasadena, California, I talked to Dr. Ronald F. Scott, a soil engineer from the California Institute of Technology, who sent commands to the device on the moon (opposite). He took me into a cavernous workshop where a mock-up Surveyor was still being used for post-flight tests.

Together we worked the remote controls that scissored the digger out a distance of five feet and moved it sideways and up and down. At our command its steel jaw opened, closed gently on a roll of tape, and held it up—like a newly trained puppy waiting for a reward.

"You may remember," Dr. Scott told me, "that we used the digger in several kinds of tests on the moon. We pressed the closed jaws hard into the soil and measured the force required to compress the surface. We dug trenches—one of them 30 inches long and 7 inches deep. We picked up one rock fragment and tried unsuccessfully to crush it; lifted another, weighed it, and determined its density. And we broke off a chunk from a rock by lifting the digger and dropping it like a hammer" (pages 216-17).

There were, of course, other ways of assessing the lunar surface: blasting it with exhaust from Surveyor's vernier rockets to see if dust would coat the spacecraft (it did very slightly); showing in photographs the depths to which the craft's footpads sank; noting the effects when Surveyor 3 bounced twice on landing, or when Surveyor 5 skidded down the slope of a small crater.

All these tests and observations gave a consistent picture of the lunar soil. The long debate about whether the moon is covered with something like ashes, or light fluffy dust, or fragile "fairy castles" of cemented particles,

or hard rock, was settled. The surface, at least in the five regions where Surveyors landed, is made up of gray, finely divided, granular material that is slightly cohesive, much like terrestrial garden soil.

Professor Thomas Gold at Cornell likens it to cement powder (page 213). Dr. Shoemaker says it is more gritty than that, with a wide range of particle sizes. He calls it a regolith, or debris layer.

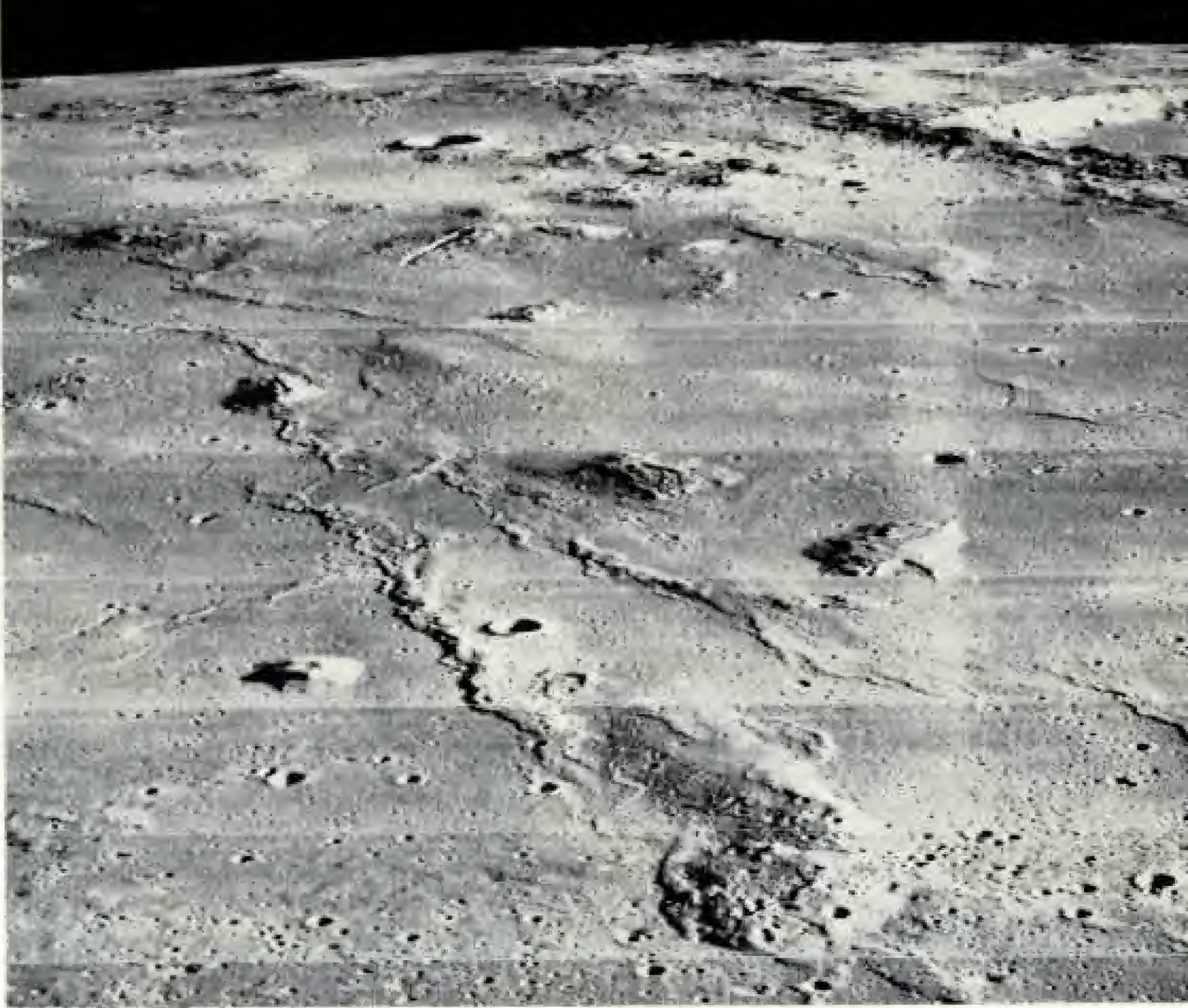
"You can compare it to fine river silt, if you like," Dr. Scott told me. "In fact, we have a big tank of silt here, from the Arroyo Seco near this lab, with which we experiment; it acts much like lunar soil when the digger plows through it."

As I tested the feel of the material with my hand, he re-created for me the scene of the first groundbreaking on the moon. A surface sampler identical to the two operated on the moon had been set up to test various soils in the tank. A huge parabolic mirror far up in a corner of the ceiling focused brilliant light on the scene, throwing dramatic long shadows just like those in Surveyor photographs. Chains and springs slung from the ceiling suspended the tank, allowing it to "give" when the digger bit in, thus permitting a measurement of how much force the sampler exerted on the soil.

Commands to the instrument came not from manual controls, as on the mock-up Surveyor, but from a computer, which in turn was controlled by coded instructions punched on a paper tape, just as it was on the Surveyor 7 mission. Four tiny motors in the digger whined, whirred, whoofed, and whiffed, each with its own characteristic obbligato, as the miniature backhoe jerkily extended, positioned itself over the soil, and dug in.

Indeed the results did resemble those on the moon—a clean trench with little slumping. Loose material brought up by the hoe clumped together in clods. Clearly the bulk of the material on the surface of the moon must be at least as fine as this. Anything as coarse as beach sand would not act the same way.

Even before Surveyor, most scientists had abandoned any idea that the moon was surfaced with hard rock. Tests from earth showed that the lunar surface reflected and polarized light and bounced back radar beams in a way that only fine particles can do. But one question had been far from settled: How deep is the soil? Some scientists were sure that it was a very thin layer, a few inches at most; others



Historic evidence of a "hot" moon. This Orbiter 2 picture of the bleak Marius Hills helps resolve a classic lunar controversy: Whether the moon has forever lain cold and inert, disturbed only by external impacts, or whether it once was molten like earth's core today. Studying the Marius features, most experts now agree that many of the domes, rising as high as 1,000 feet, are outpourings of lava. They find a parallel on earth in domes such as 500-foot-high Howard Mesa (below) in Arizona's San Francisco volcanic field. Ridges on the Marius field may be lava forced up through fractures, or bucklings of the lunar crust. Marius crater, upper right, gave its name to the region.



U. S. GEOLOGICAL SURVEY



NASA

Look-alike craters on earth and its moon give credence to the impact theory of the origin of many lunar features. Arizona's Meteor Crater (upper), 4,000 feet across, was blasted out by the crashing blow of a meteorite, perhaps no larger than the museum building perched on the near rim. Geologists find strong similarities between Meteor and an unnamed lunar crater (lower), about half Meteor's width. Both have raised rims and surrounding "aprons" of ejected material, hummocky and strewn with boulders. Hills within lunar craters, as at right, may be caused by the rebound of subterranean rock. What appears to be a mound inside Meteor Crater grew as tailings from a mine shaft, sunk in the early 1900's in an unsuccessful attempt to locate the iron-rich meteorite.

predicted that it might be thousands of feet deep in the maria.

Dr. William L. Quaide and Verne R. Oberbeck at NASA's Ames Research Center, near San Francisco, have an answer that is becoming widely accepted. After years of experimenting and after studying thousands of Orbiter, Surveyor, and Luna photographs, they are certain that the mare filling has been pulverized and churned to depths varying from 3 to 30 feet by the incessant rain of small meteorites striking the moon. In the highlands the average depths seem to be somewhat greater. The top of this layer, of course, is littered with coarse boulders and fragments of infinite variety and size.

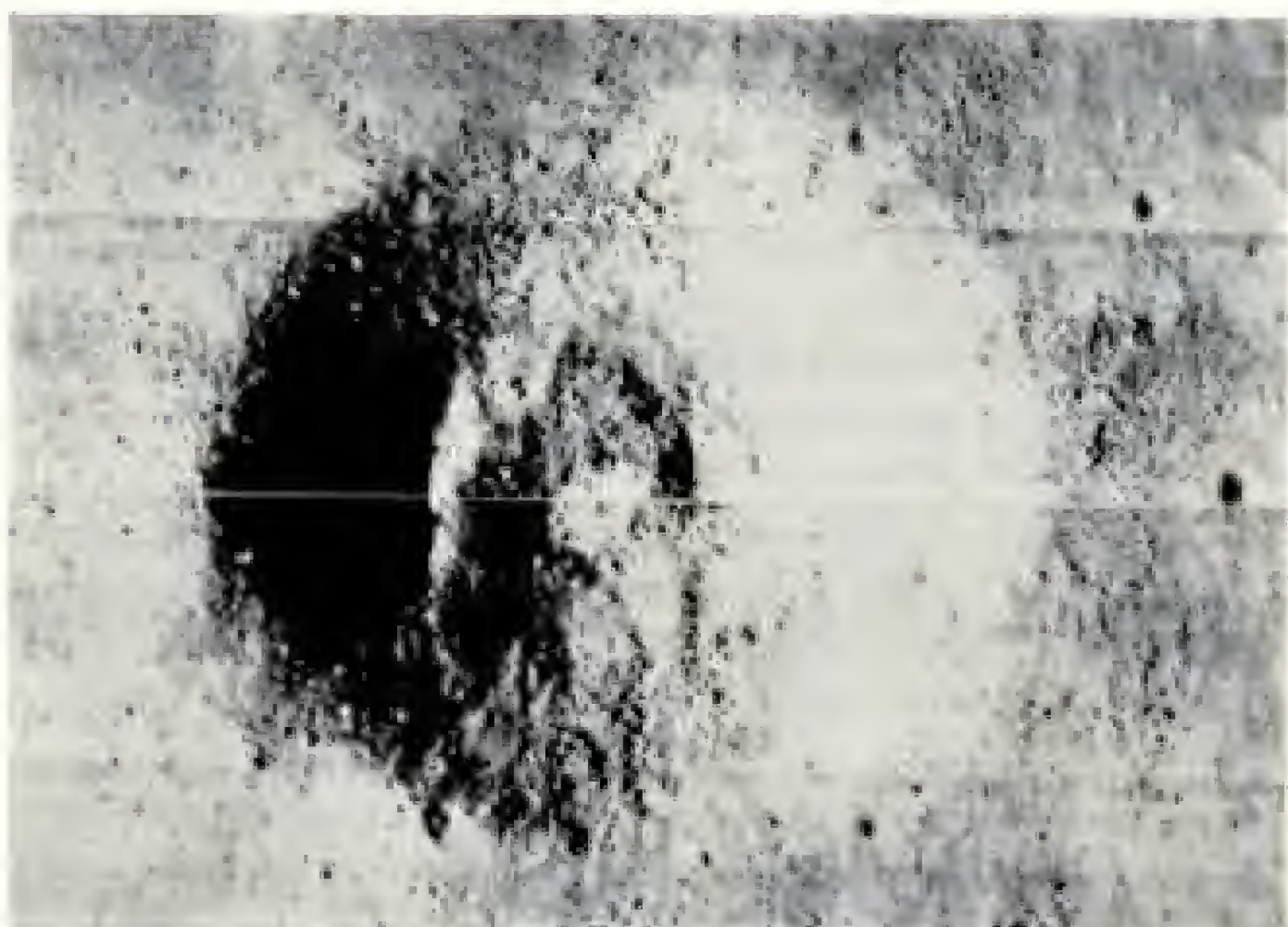
These scientists see overwhelming evidence that at least the smaller craters—those no more than half a mile across—are the direct result of meteorite impact, or of the impact of rocks thrown from other craters.

These conclusions were strongly supported by the work of another Ames scientist, Donald E. Gault (page 212), who invented a clever device known as the "vertical light-gas gun" to reproduce the effects of a meteorite. The gun fires small plastic or metal projectiles straight down, or at an angle, into targets inside a vacuum chamber.

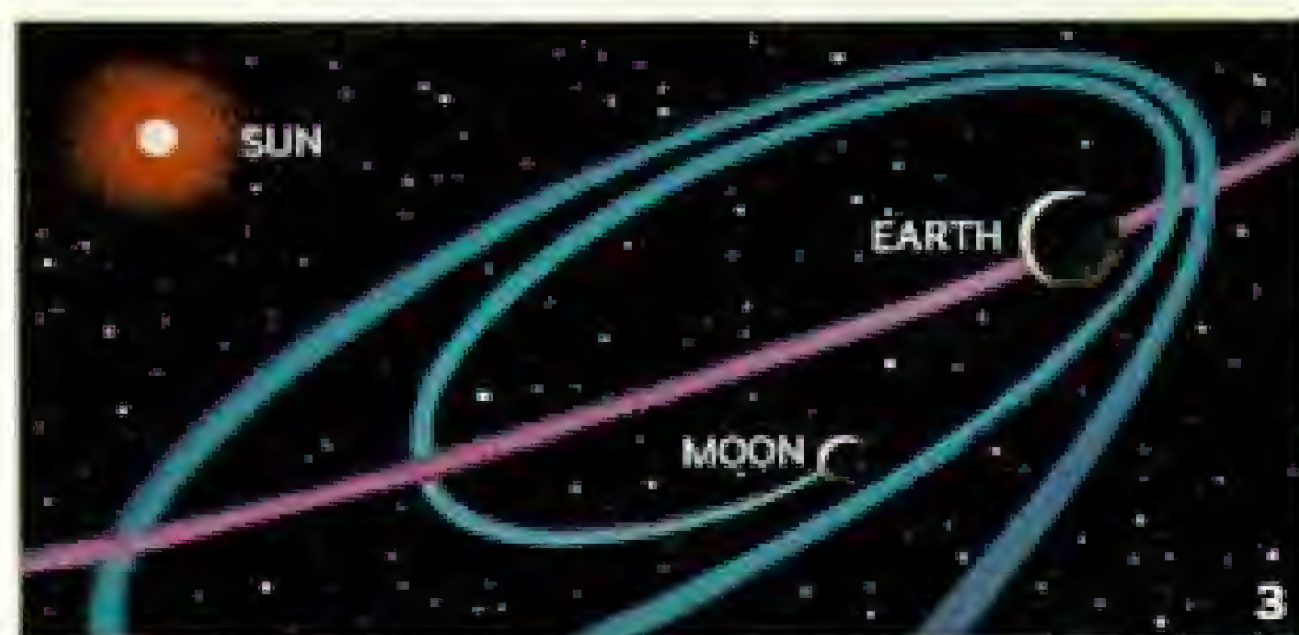
"We can get velocities of as much as 28,000 feet a second,"



AP/WIDEWORLD © NASA



AP/WIDEWORLD © NASA



ILLUSTRATIONS BY DEBBE WILCOX © 1981

How did earth get its moon? Just as experts debate the causes of the moon's configurations, they dispute its origin. Three theories predominate. 1. In the "sister" hypothesis (top), earth and moon formed at the same time from a vast cloud of cosmic matter that condensed into the bodies of our solar system. 2. The "daughter" theory contends that the earth once rotated so rapidly that it became blimp-shaped and tore in two. The smaller blob of matter entered into orbit as the moon. 3. The "spouse" theory holds that the moon came from elsewhere in the solar system. Sweeping too near, it was snared by earth's gravity and "married"—locked in orbit.

Nuggets of moon matter—so Dr. Dean Chapman claims of these tektites, gathered from Southeast Asia, the Philippines, and Australia. The glassy blobs indicate by their shapes and surface sculpture that they have passed through earth's atmosphere. Dr. Chapman, an aerodynamics specialist at Ames Research Center, believes with a number of colleagues that tektites are lunar fragments hurled into space during meteorite collisions with the moon.

After he acquired a number of huge tektites for his collection, a fellow scientist spoofed him by painting a super-tektite for his wall.

Mr. Gault told me as he prepared his gun for a demonstration. "That's nearly ten times the speed of a military rifle bullet, and it simulates the effects of a small meteorite striking the moon. We reproduce the lunar environment as closely as we can by putting the target in a vacuum and by dropping the target just fast enough at the precise moment of impact to simulate the moon's low gravity."

Hydrogen gas compressed by a powder explosion propels the missile for maximum velocity, but for our experiment we used a simple powder charge. We watched through a heavy quartz window as the pellet smashed into a bed of fine-grained sand, leaving a rimmed crater many times its own size.

"That rim is the significant thing," said Mr. Gault. "When we fire the gun at rocks, we can knock out a rough hole, but we never get a rim like that, and we don't get small craters that look like that. But with granular material, or with such material over a hard rock layer, we can duplicate all the different

kinds of small craters we see on the moon.

"With this help," Mr. Gault went on, "scientists can calculate the depths of the fine surface material from the photographs, either by the shapes of the craters or by determining how deep craters have to be before the impacts begin to excavate subsurface rock."

Large craters, of course, have broad "ejecta aprons" of rocks and boulders. These have probably come from much deeper than the present crater bottoms, however.

The very large craters were originally as much as six or seven miles deep, and the largest of the circular maria—Imbrium—may have been 50 miles deep for a very brief time. Many scientists think that the bottoms of these vast chasms rose to compensate for the loss of material. In addition, volcanic material has partially filled many of the pits.

As Dr. John O'Keefe of NASA's Goddard Space Flight Center at Greenbelt, Maryland (page 213), puts it, "The moon just won't accept an insult like that. It reacts!"



AP/WIDEWORLD

Upon the corner of
the moon
There hangs a vap'rous
drop profound.
I'll catch it ere it
come to ground.

SHAKESPEARE, "MACBETH"

In times gone by, superstitious folk believed that witches could call down a vapor from the moon for use in their incantations. But something far more solid than Hecate's "vap'rous drop" may indeed reach earth from the moon, if the findings of an Ames scientist named Dean Chapman are correct.

He demonstrates quite convincingly that certain tektites, small blobs of black glassy material found from Australia to Southeast Asia, splashed to earth when Tycho was formed, less than a million years ago.

Dr. Chapman is an aeronautical engineer who holds top rank as an expert in ablation—the melting and sloughing away of objects flying through the atmosphere at high velocity. His knowledge helped design the heat shields that protect American astronauts re-entering the atmosphere after space flights.

No one else in the world has so varied a collection of Australasian tektites as does Dr. Chapman, and no one else has studied these strange objects so thoroughly. The chemical makeup of tektites is unlike that of any other material on earth.

"We can tell by experiments and by examination of certain of the tektites from Australia that they must have been melted twice," Dr. Chapman told me. "The first time was in a vacuum, as on the moon, because the molten material took the form of a ball; and the second time was in earth's atmosphere, because of the way these glass balls have ablated on one side."

He showed me a tray full of samples. They looked like flanged hemispherical buttons.



"Potassium-argon and fission-track dating tell us they melted about 700,000 years ago," he continued. "We know how fast they were traveling by the way they have melted. And by their distribution on earth we can calculate their trajectories. All this points squarely toward the southern part of the moon for their origin, and Tycho fits exactly. We believe it is a relatively young crater, about the same age as the Australian tektites, because its rays have not yet eroded away."

Not all scientists agree with Dr. Chapman, but he gets support from his colleagues at Ames, such as Don Gault; from John O'Keefe, who has long argued that tektites come from the moon; and from Gene Shoemaker.

"The earth is strewn with lunar debris," says Dr. Shoemaker. "A meteorite striking the moon at tremendous speed can eject hundreds of times more material than its own mass. Some of this material goes so fast that it escapes the moon's gravitational pull and travels freely in space. Earth continually sweeps up these sprays of moon stuff."

Tens or hundreds of tons hit the earth's atmosphere daily, he says, much of it to burn out and sift to the ground as dust, and a

small fraction to crash-land as solid chunks.

Strenuous efforts, of course, are made to find such meteorites. Eugene E. Horton, at the Manned Spacecraft Center in Houston, tells a story about Project Moon Harvest, which several years ago enlisted the aid of farmers in seeking likely rocks in Midwest fields that normally are rock free.

One old farmer said to the investigator, "Now what exactly is this you are looking for, young man?"

The scientist explained, "We're looking for moon rocks—that's what you might call it."

The farmer, with eyes twinkling, replied, "Well, fella, have you looked in your head?"

A ruined world,
a globe burnt out,
a corpse upon
the road of night.

SIR RICHARD BURTON,
"THE KASIDAH"

Is the moon cold and dead? Or is it, like the earth, a living body with a hot interior? Schopenhauer, more than a century ago, wrote of "the frozen moon." In 1901, H. G. Wells described it as a dead world of extinct volcanoes and lava wildernesses, alternately blazing, then freezing in absolute zero.

More recently, in the mid-'40's, when the U. S. astronomer Ralph B. Baldwin had begun the intensive studies that qualify him as the moon pioneer of the 20th century, a professor said to him, "Why are you wasting your time on the moon? It is dead and gone!"

But Baldwin persisted, and today a large part of the scientific community would agree with him that the moon is indeed hot inside—and very much worth studying. In fact, he says, "Surveyor has killed off the possibility of a cold moon."

Surveyor's evidence came primarily from a six-inch box, gold-plated to reflect the solar heat, that was carried on each of the last three voyages. This radioactive instrument, known as an alpha back-scattering device, was conceived by Professor Anthony L. Turkevich of

the University of Chicago to make a chemical analysis of the lunar soil (pages 216-17).

When the instrument was lowered to the surface, a bit of radioactive curium bombarded the lunar soil with alpha particles, heavy atomic particles equivalent to the nuclei of helium atoms. Some of the particles bounced back up. Detectors inside the box counted them and measured their energy.

The secret of this device lies in the fact that alpha particles scatter, or bounce, from heavy elements, like iron, more vigorously than they do from lighter ones, such as carbon or oxygen. It is like bouncing a rubber ball against a stone wall, a barn door, and a cardboard box; clearly the ball will bounce farther from the wall than from the door, and farther from the door than from the box. Dr. Turkevich and his colleagues had determined in advance what kind of response to expect from each chemical element the instrument might find on the moon.

When Dr. Turkevich made his first report of alpha back-scatter findings, chemists, physicists, and geologists held their breath. Would it indicate some exotic material, unlike any found on earth? Would it be stuff like that of the primordial earth before it melted and the greater part of its heavy iron and nickel sank to a central core, leaving lighter stuff behind? Or would it be like the familiar rocks in the earth's crust—granite or basalt, for example? Several cherished theories would rise or fall according to the findings.

As had been long predicted by Ralph Baldwin and by Dr. Gerard P. Kuiper, Director of the Lunar and Planetary Laboratory at the University of Arizona (page 212), the lunar soil which Surveyor tested is very much like basalt, the most common volcanic rock on earth. A basalt layer several miles thick probably underlies all the earth's ocean beds, and basaltic lava flows cover thousands of square miles in such places as the Columbia Plateau in Oregon, the Deccan Plateau of southern India, and Iceland.

The basalt-like material on the moon is made up of the same elements that are commonest on earth: oxygen, silicon, aluminum, magnesium, calcium, and iron. The maria differ from the highlands chiefly in that the maria are twice as rich in heavy metals such as iron and nickel. This could help explain why the maria are darker: On earth, compounds of iron and other metals darken rocks and reduce their ability to reflect light.

The significance of finding basalt is that it strongly suggests a hot moon. Basalt on earth always comes from an igneous process—that is, it has been produced by melting and solidification. Moreover, when a planetary body melts, the heavier materials separate from the lighter in a process called differentiation. Basalt is a differentiated rock. So, from the alpha back-scatter results, most experts conclude that the moon must have been hot at some time in its history.

How did the moon get its heat? Experts suggest three possibilities, the same sources that account for the earth's heat: (1) from the energy of gravity when the chunks of matter forming the moon first rushed together; (2) from the heat of decaying radioactive elements such as potassium, uranium, and thorium; and (3) from mechanical processes such as the flexing of the moon's crust because of tidal forces.

And astrophysicists say that once a body the size of the moon heats up enough to melt its interior, it cannot be cooled down within the time we believe the moon to have existed—4½ billion years, the same age as earth. So the moon not only was hot, it still is, in the view of an increasing number of authorities.

If the moon is cool outside and hot inside, geologists say that it suffers severe stresses that must produce moonquakes. We see evidence of such jarring in the slumping of crater walls and the general downhill creeping of material. One Orbiter picture clearly shows the tracks of two rolling stones (page 236).

As evidence for a hot moon increases, one of the hottest debates in the whole field of lunar studies is cooling off slightly. That is the argument over whether the craters and other formations on the moon are volcanic in origin or were caused by impacts.

Many years ago everything was laid to volcanism. Then the careful studies of Ralph Baldwin led a number of people to believe that meteorites had caused most if not all of the moon's basins and craters, although Baldwin himself never went that far. Now the pendulum is swinging back again, and the majority of scientists see both processes at work. Some structures are generally recognized as impact craters, and others are more likely volcanic. Still others may show volcanic effect after the original formation by impact.

Two holdouts still stand at the two extremes. Dr. Jack Green, a lunar expert at the

McDonnell Douglas Corporation in Huntington Beach, California, believes that more than 95 percent of the major lunar surface features are volcanic in origin. Yet he admits that "there must be some large lunar impact craters; for there are such craters on earth."

But Professor Thomas Gold, author of the early deep-dust theories, sees it the other way. "I am yet to be persuaded that there ever was any large-scale volcanism on the moon," he told me. "I think there is no hard evidence."

In between are all shades of opinion. Dr. Kuiper, who feels that too much attention has been given to impact theories, contends that many craters have been caused by subsidence of subterranean lava chambers.

And one of his associates at the University of Arizona, Robert Strom, says, "As I see it, about 10 percent of the craters are clearly impact-created, about 10 percent are volcanic, and the rest are uncertain. We will probably have to fight it out crater by crater!"

One thing everyone agrees on: There are no huge volcanic cones, like Mounts Fuji or Rainier, on the moon. And no clear-cut volcanic eruptions or lava flows have ever been observed to occur. For that matter, no one has ever seen a meteorite or a comet strike the moon. Of course, man's observation of the moon has covered only a moment in the long eons of lunar geological history.

But people have seen something else which excites suspicion that volcanic fires are still lit. In March 1587, an English observer wrote of seeing a bright spot on the moon "directly between the pointes of her hornes, the mone being chaunged not passing five or six daies before." In 1855, another observer wrote in the *Monthly Notices of the Royal Astronomical Society* that he had seen with his 10-inch telescope "two luminous spots, one on either side of a small ridge . . . of a yellow flame colour, while all the rest of the enlightened part was of a snowy white. . . . I observed it for five hours."

One could disregard such reports were it not that they number more than 800, many of them from respected astronomers. The sightings have been concentrated in a few locations, notably the craters Aristarchus (brightest spot on the moon) and Alphonsus. They take the form of temporary bright spots, red glows, red and blue bands, veils, violet tinges, and other peculiarities known generally as transient phenomena.



EXPERIMENT BY HALPH. BOWEN FOR NASA

Rehearsing for M-Day, men and machines train on simulated lunar landscapes. At NASA's Manned Spacecraft Center in Houston, Texas, Astronaut Dr. Don Lind sets out a seismometer designed to measure moon-quakes. Aluminized ground cloth will deflect the 243° F heat of the lunar noon. This and other devices cram a compact kit, background, called ALSEP—Apollo Lunar Surface Experiments Package. Carried to the moon on an early manned landing, the instruments will radio scientific findings back to earth for as long as a year.

With an instrument for testing magnetism slung from its boom (right), a training vehicle threads a realistic reconstruction of a lunar crater field near Flagstaff. Some sort of roving, instrument-laden vehicle will one day traverse the moon to map its features and minerals. The Arizona field yawns with pits up to 80 feet across and 25 feet deep, blasted in volcanic soil by the U. S. Geological Survey.

In 1958, powerful impetus was given to the idea of "red spots" on the moon when a Russian astronomer, Nikolai Kozyrev, not only saw a bright "cloud" on or near the central peak of Alphonsus but also managed to record the phenomenon in a spectrogram.

And then in 1963 two United States observers, James C. Greenacre and Edward Barr, at the Lowell Observatory in Flagstaff, Arizona, both saw the same peculiar sight: three reddish patches near Aristarchus that lasted only half an hour.

There could be no doubt—something strange happens sporadically on the moon. NASA became so interested that the following year it supported Operation Moon Blink, with volunteer observers at a number of observatories to watch for transient phenomena.

These observers use a special device on their telescopes—a rotating filter wheel with



an image tube—that causes any color spots on the moon to blink rapidly. So far Moon Blink teams have observed 10 such phenomena, of which 3 have been separately confirmed.

One analysis of the dates of sightings reveals a curious fact: The events happen much more frequently when the moon is closest to earth (when tidal forces distorting the moon's crust—81 times as great as those on earth—are at their peak), and again when the moon is farthest away (when its crust goes through maximum relaxation from such distortions).

Faced with this evidence, a few scientists have suggested that under the stress of tidal forces fractures open in the moon's surface, allowing gases to escape. These elusive gases might be from volcanic sources, or they could be cold gases fluorescing under solar radiation. Few entertain any idea, however, that they are flows of molten lava.

The innocent moon,
that nothing does but
shine, Moves all the
labouring surges
of the world.

FRANCIS THOMPSON,
"SISTER SONGS"

Anyone who has sat by the sea and observed the unfailing regularity of the tides knows something of the mysterious gravitational force the moon exerts on earth. That force affects not only the waters but

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BOOK REVIEW BY NATIONAL GEOGRAPHIC SOCIETY



the land as well. It creates a tidal bulge in the earth's surface that, like a wave, moves around the earth with its crest pointing directly toward the moon.

No, not quite. Because of friction within the earth, and because the earth is spinning so much faster than the moon is orbiting, the bulge is dragged slightly forward in the direction of the earth's rotation.

To picture this in your mind, imagine that the earth is the face of a clock, and that the moon at this moment hangs directly above it at twelve o'clock. Theoretically the earth's bulge should also be exactly at twelve o'clock, right under the moon.

But as the earth turns, it makes a full rotation in only one day; the slower moon takes more than 29 days to cover the same circle. So the bulge on earth tends to get dragged forward, and (in our imaginary model) points to one o'clock instead of twelve. This means that it is always moving slightly *ahead* of the moon. Now, because of the laws of gravity, that tiny bulge gives a continuous extra pull whose effect is to tug the moon forward and thus speed it up. The same force, working in reverse, tends to slow earth down.

As any astronaut can tell you, if you attempt to speed up a satellite it immediately goes into a higher and larger orbit and slows down—and that's exactly what happens to the moon.

This might all sound like theoretical nonsense were it not for evidence that it is all happening, and has been happening for many hundreds of millions of years.

For example, studies of daily and monthly growth lines in fossil corals suggest that in the Devonian Period, 350 million years ago, earth days were only 21.9 hours long and there were about 400 days in a year instead of 365. Our planet did indeed spin faster then.

And astronomers, making very exact checks on the position of the moon against the stars, discovered long ago that the moon is taking longer and longer to make its circuit. It is, in fact, steadily pulling farther and farther away from us.

Today, by timing radio signals from earth relayed back by Lunar Orbiter, the moon's distance has been measured with an error of less than 1,000 feet. It varies throughout the month by about 31,247 miles, but the mean distance, center to center, is 238,856 miles.

How close might it have been in earlier times? Scientists naturally have pondered

this intriguing question, and have made intricate calculations. Dr. Gordon J. MacDonald, a geophysicist and a vice-chancellor of the University of California at Santa Barbara, finds that the moon would have been only 11,000 miles from earth less than two billion years ago. It could not have been much closer without shattering into fragments. Tides on earth, with the moon at such a distance, would have been a thousand times higher than they are now (assuming there were oceans then).

All this raises wonderful and fascinating questions about the moon's origin. Did it come into being at the same time as earth, as a sort of sister planet? Did earth at some early stage divide like an amoeba and give birth to the moon, as a daughter? Or did the moon come into being in some other part of the solar system, and, on one swing of an elliptical orbit, come so close to the earth that it was captured, like a spouse (page 222)? Or were there once a number of small moons that were swept up and coalesced into one? All these hypotheses have adherents.

Answers to such questions are not easy, but it is precisely such questions that astronauts and cosmonauts have in mind as they approach the moon. And it is clear that they will find that scarred and buffeted celestial wreck a far more complicated and interesting place than most people have supposed.

The first American astronauts on the moon will probably be able to do little more than gather a few pounds of samples—and each of the 130 scientists back on earth who have been chosen to study and analyze those samples hopes against hope that some of the material will represent the moon in its infancy.

Later astronauts will deploy a group of instruments on the moon, complete with their own nuclear power supply and a transmitter to send continuous information to earth about such things as moonquakes, solar wind, the flow of heat, and magnetic fields (page 226).

Still later will come roving vehicles, manned and unmanned, to traverse the bleak lunar terrain. And finally will come colonies, small bands of hardy men who, like their pioneer forefathers, will bend an unfriendly environment to their needs.

"It is strange to think," as Arthur C. Clarke says in *The Promise of Space*, "that in a few more years any amateur astronomer with a good telescope will be able to see the lights of the first expeditions, shining where no stars could ever be, within the arms of the crescent Moon." THE END

For an artist's view of a future moon colony, fold out the opposite page. ►



Frontiersmen of the Space Age, engineers and technicians colonize the moon. Drawing on the most advanced thinking of experts, artist Davis Meltzer portrays a lunar outpost that might be possible in a generation. A survey team drills core samples and maps the surface as an attendant monitors the oxygen supply. Aluminum habitation modules lie almost buried for protection against micrometeorites and temperatures that fluctuate 500° F. between noon and night. In a laboratory module, foreground, biologists observe animals and experiment with raising vegetables in fertilized water. A multi-level main module encloses dressing rooms

for entering and leaving, medical dispensary, dormitory, kitchen, and dining and recreation areas. Pressurized tunnel leads to a smelter, where lunar rock quarried on the surface is processed for the water chemically locked within it. The water not only fills the station's swimming pool, but also yields oxygen for breathing and hydrogen for fuel for a flying vehicle, far left. A fence-like radio telescope probes deep space, and an optical scope in a small observatory studies the heavens, undimmed by earth's atmosphere. Beside a hangar pit, a commuter rocket poises for return to the blue planet earth.





A NINE-PAGE PORTFOLIO

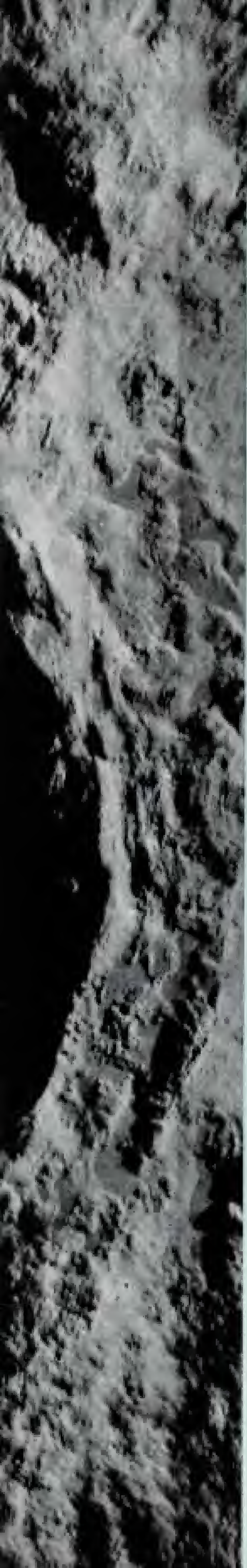
Awesome views of the forbidding moonscape

Badlands of the crater Copernicus loom menacingly in this extraordinary photograph taken by Lunar Orbiter 2 on November 13, 1966. As the picture-taking U.S. satellite swept past the moon 30 miles high, it captured this spine-tingling panorama—acclaimed “the picture of the century.”

The tremendous sense of being on the moon derives from the camera's oblique shooting angle, plus the distance-shrinking power of its telephoto lens. Instruments aboard the satellite scanned the original film in bands and transmitted them bit by bit to earth in digital form; a computer reassembled the picture.

Lunar Orbiters photographed 99.6 percent of the moon's surface while probing for Apollo landing sites. Though the first manned craft will land in smoother regions, Copernicus will be an early target for exploration. Sequences of rock formations visible in its plunging walls will offer lunar geologists a look back through time into the moon's early history.





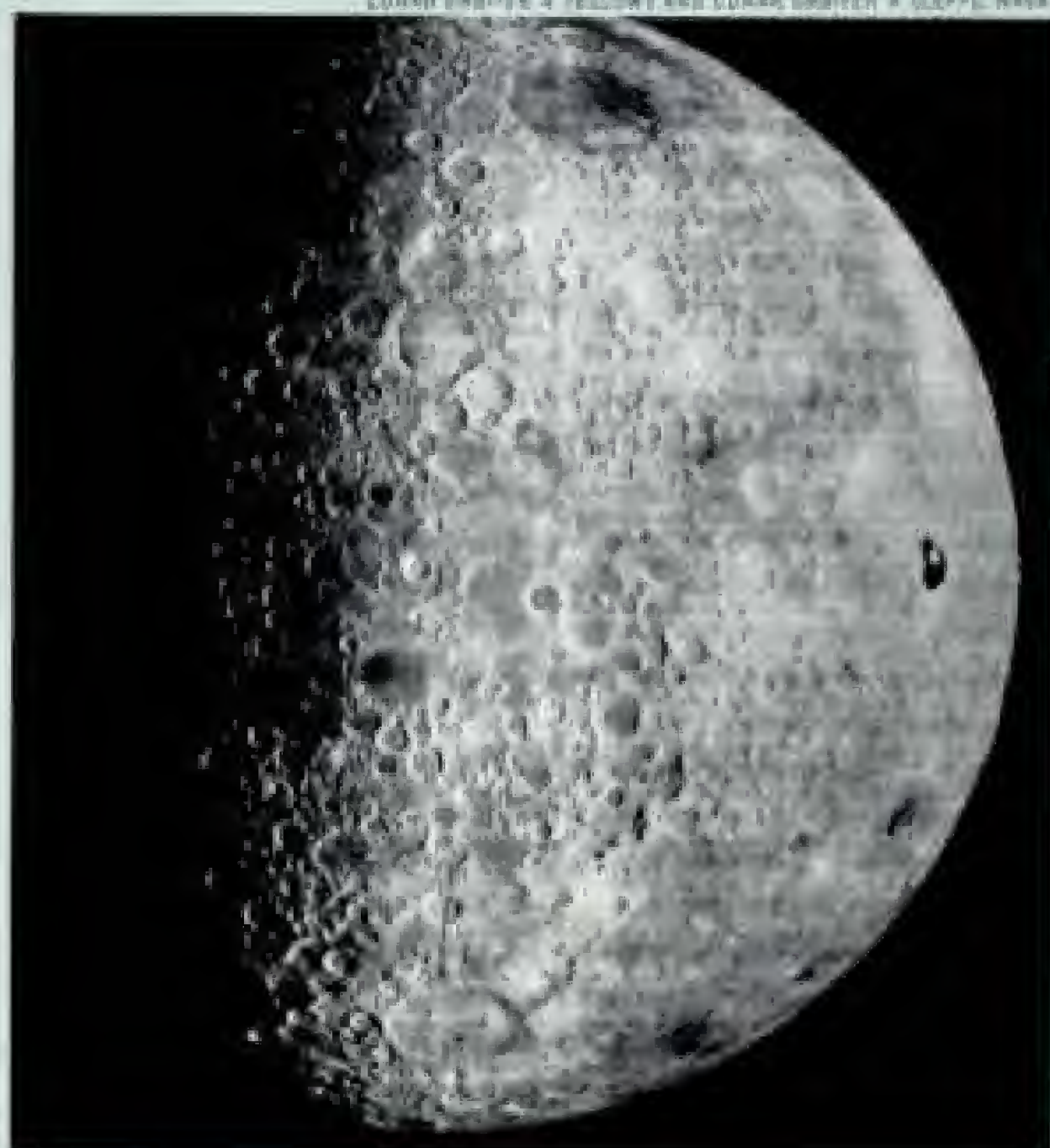
MOON: WILSON AND FORDMAN OBSERVATIONS

Familiar lunar face, seen through an earth telescope, flaunts its silver-and-black brocade of dark maria, bright highlands, and sequinlike craters. Flashy rays of the crater Tycho beguiled some into mistaking it for a south pole. Today the rays are thought to be highly reflective material spewed out or uncovered at Tycho's cataclysmic birth.

Crater Tycho's yawning mouth, 54 miles in diameter, pokes out a tongue of stone 7,000 feet high. The crisp rim and untarnished rays indicate that Tycho is recent by moon standards. Surveyor 7 soft-landed on comparatively smooth terrain just beyond the crest of the rim at upper left.

Around-the-corner glimpse from 1,856 miles shows a profile never seen from earth. Shadow blots out nearly all of the moon's front face. Tsiolkovsky crater, the dark patch at right center, pocks the orb's far side. The bright spot within it is a sun-struck peak, similar to Tycho's.

LUNAR ORBITER 4: YELLOW; EMBL LUNAR ORBITER 4: ORBITAL VIEW





Long channel on the moon's face, the two-mile-wide Hyginus rille contains a chain of holes—possibly rimless volcanic craters or depressions formed as the floor of the rille subsided or collapsed. Relatively straight except for a dogleg, the rille probably formed from a tension fracture of the lunar crust. Other, quite different rilles, more meandering or sinuous, may have been made by flows of ash, lava, or water.

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Startling signs of movement in an eerily silent world, two boulders—one of them as big as a house—have left clearly visible tracks several hundred yards long down a slope of the crater Vitello. What dislodged them? Some scientists say a relatively recent moonquake, on the theory that the moon is still a living, self-changing body like the earth.



ALL BY LUNAR ORBITS II. 1968

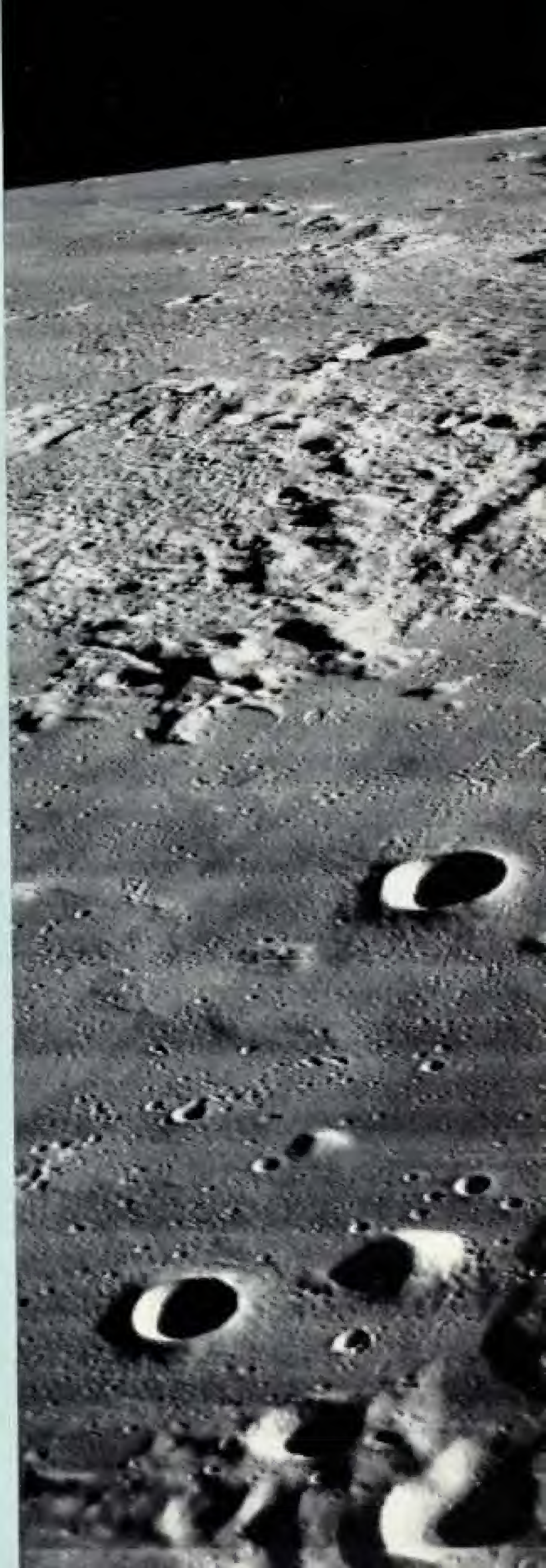
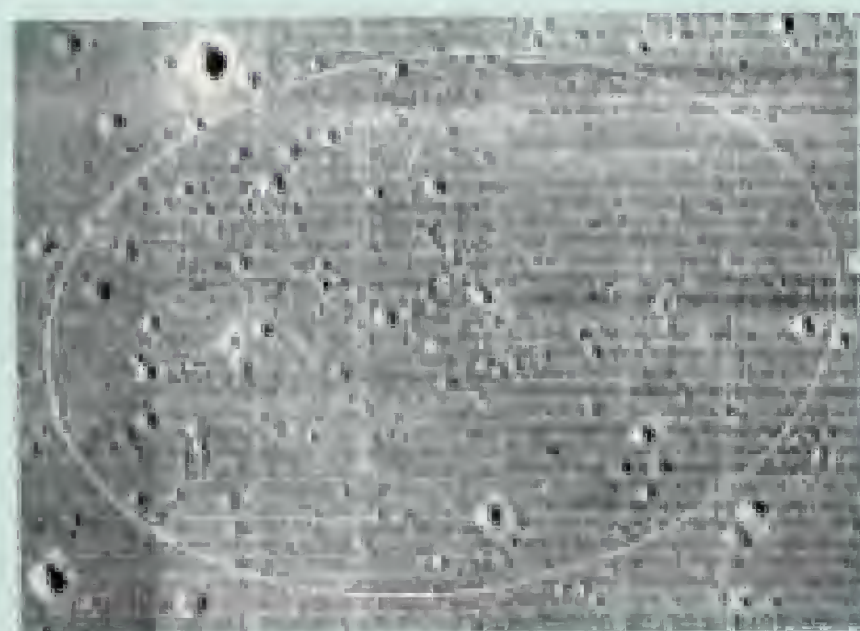
River bed on the moon? An eye accustomed to earth's landscape might identify the snakelike rille within the 75-mile-long Alpine Valley as a river channel. In fact, some experts believe that this and other rilles may indeed have been carved by rivers during a period when the moon had a temporary atmosphere. The Alpine Valley itself, most agree, was formed by faulting of the moon's crust in a process not unlike that which created earth's Great Rift Valley. Later, after debris or lava smoothed the valley floor, the rille evolved from flow or subsidence. The valley slashes through a range of rugged mountains called the Alps, part of the rim of smooth Mare Imbrium.



Apollo landing

As their spacecraft slows for its historic touchdown on the moon, two U.S. astronauts may well shiver in awe at this very view of Kepler crater (right). If the Kepler region proves to be the target, their spindly-legged Lunar Module (above) will probably land just beyond the lower left corner of this Lunar Orbiter 3 photograph.

The blue dots on a telescopic view (below) represent three potential Apollo landing sites. Kepler is the bright-rayed crater at lower left. The oval in the mosaic strip map (bottom) shows a close-up view of the area within the blue dot nearest Kepler. (See supplement map, *The Earth's Moon*, for the five proposed Apollo landing sites.)





How We Mapped the Moon

By DAVID W. COOK
National Geographic Staff Cartographer

THANKS to the full photographic coverage flashed back to earth by United States Lunar Orbiter spacecraft, the National Geographic Society this month presents to its 6½ million members a unique wall map, **The Earth's Moon**.

This special supplement to the February **GEOGRAPHIC** shows the moon in two hemispheres—not only the familiar face constantly turned toward our planet, but also the largely hidden far side, heretofore a synonym for all that is mysterious, remote, and unknowable.

Look along the equator of the moon's near side and you will see, marked in red, the five landing sites proposed for our Apollo astronauts. The final choice will largely depend upon the date of lift-off from earth.

Almost exactly in the center, very near Landing Site 3, lie Surveyor 4, which crash-landed in July 1967, and Surveyor 6, which set down gently nearby in November of the same year. Our first lunanauts may see those pioneer mooncraft.

The map shows in red the final resting places of all but one of the 23 unmanned spacecraft that have reached the moon's surface, 17 American and 6 Soviet. The crash site of one U. S. craft, Orbiter 4, is uncertain.

In 1959 and 1965 the Soviet Union's Luna 3 and Zond 3 looped around the moon and sent back the first photographs of the far side. But the pictures lacked sharp detail, and vast areas were not photographed at all. It remained for the United States space program, under the National Aeronautics and Space Administration, to obtain the first complete and detailed record of the moon's geography—more accurately, selenography, from *selenē*, the Greek word for moon.

Putting moon craters where they belong: The Society's cartographic staff built this ingenious rig to fix the exact position of the thousands of features on the Society's extraordinary new map, **The Earth's Moon**. Using a 40-inch earth globe to represent the moon, Richard R. Furno adjusts a camera to simulate the distance from which a Lunar Orbiter spacecraft made the photograph hanging above. David W. Cook, author of this article and designer of the map, turns the globe to align it with the camera, while photographer Victor R. Boswell, Jr., positions lights. The picture thus obtained establishes the precise latitudes and longitudes of lunar features shown in the Orbiter view.





A map is born

CRATER BY ENDLESS CRATER. National Geographic men fill in details of the moon's incredibly pocked far side.

Using data from the process shown on the preceding page, cartographer Furno (below) transposes grid marks onto a photograph of the crater Tsiolkovsky, a prominent feature of the far side. After placing a plastic grid on the Orbiter picture, he pinpricks holes through the overlay onto the photograph where the lines intersect, then connects the holes by lines that become parallels and meridians.

With airbrush and hold-down stick, artist Tibor Toth uses the grid-marked Tsiolkovsky photograph as a guide for portraying features heightened by shadows (right). To adapt Geographic relief-mapping techniques to the portrayal of lunar features, he trained under Terence C. McCann at Lowell Observatory in Arizona.

Because the Orbiters snapped photographs at various times of the lunar day, shadows vary in each picture according to the angle of the sun. To make the Society's map, Mr. Toth showed all lunar features as if lighted by a setting sun.



PHOTOGRAPHS BY DAVID L. MOORE. © N.G.S.



Aiming moonward, David L. Moore focuses a Nikon F camera attached to a Questar reflecting telescope. A built-in motor, synchronized with earth's rotation, slowly pivots the 15-inch telescope to follow the moon as it arches across the heavens. This precision tracking makes possible long exposures on fine-grain film, thus improving photographic detail. From his pictures, Mr. Moore made 11 map drawings that illustrate the phases of the moon.



In 1966 and 1967 five Lunar Orbiters circled round and round the moon, swinging from nearly 4,000 miles above its surface to less than 30. By radio, strip by strip, they sent back thousands of pictures of the high quality that cartographers dream about (pages 210 and 234, for example). All together they covered 99.6 percent of the moon.

But before the Orbiter photographs could be used as the basis of our map, they had to be fitted with a grid of latitude and longitude. Staff cartographer Richard R. Furno came up with the solution.

"Why not," he asked, "take a globe with lines of latitude and longitude and let it represent the moon? Then we can photograph it from the same relative altitude and position from which each of the Orbiter photographs was taken. For each picture we have the data needed to position the camera."

In the spacious old library of the National Geographic Society's Hubbard Hall, we built such an apparatus (pages 240-41). Then we began taking hundreds of pictures, each from a different and carefully calculated point in relation to the globe. This took us about three months, but it gave us a grid that precisely located each moon mountain, mare (Latin for "sea"), and crater (opposite page).

A True Map, Not a Picture

Traditionally, moon maps have been drawn on the orthographic projection, which presents lunar features as seen from earth. In such maps the central portion has good accuracy, but features around the sides are badly distorted because they are shown almost on edge. Now, with photographs of virtually the whole lunar sphere, we could make a true map of each hemisphere and correct this visual distortion.

For our map we chose the Lambert Azimuthal Equal-Area Projection, which shows each feature in its true direction, or azimuth, from the center of its hemisphere, and also in true area scale. A dime placed anywhere on the map will cover exactly the same area—about 10,500 square miles.

Until the Space Age, most maps showed the moon's north pole at the bottom, since astronomical telescopes turn images upside down. Ours shows the moon with north at the top, to conform with modern usage.

At first glance, all the craters may look alike. Actually, every one has some distinctive characteristic, and Hungarian-born staff

artist Tibor Toth tried to capture as many of these details as the scale of the map would permit. To enable him to become intimately familiar with the moon's pocked and ravaged face, Chief Cartographer Wellman Chamberlin arranged for him to spend several weeks at Lowell Observatory in Flagstaff, Arizona, where some of the world's most skilled selenographers have been drawing highly detailed maps of the moon for the Air Force Chart and Information Center. Then, by careful use of light and shadow, Mr. Toth made our map's relief drawings, in which each lunar feature stands out as if seen in three dimensions.

Perhaps the most striking aspect of the new map is the difference in appearance of the moon's two sides. Across the near side, particularly in the north, spread dark, level plains, the maria. Yet the far side, covered with craters, seems almost devoid of these plains. Why? Moon experts do not yet agree.

Features Indexed for Quick Location

All the more prominent features of the moon are indexed on the map and can be located by coordinates: red letters on the central meridian through each hemisphere, red numbers across the lunar equator.

Many lunar features, especially on the far side, still lack official names, since the special commission of the International Astronomical Union which is charged with this responsibility does not plan to meet until 1970 to consider the hundreds of moon features now mapped for the first time. Outstanding exceptions are three far-side features—Mare Moscovense and the craters Tsiolkovsky and Jules Verne—all named by the Russians and officially accepted.

Craters beyond number mark both the near and far sides of the moon. Copernicus, Darwin, Einstein, Colombo (Columbus), Vasco da Gama—their names read like a roll call of famous scientists and explorers. Jesuit astronomer Giovanni Riccioli in 1651 began this practice of naming lunar features for great men (see map, page 208).

Near the moon's north pole you will find craters named Peary and Byrd, for the American explorers of earth's North Pole; likewise, near the lunar south pole lie craters named Amundsen and Scott, for the Norwegian and the Briton who first reached the terrestrial South Pole 57 years ago.

Small areas near the south pole marked "Unsatisfactory Photography" remain the



LUNAR CRATER © S. MOORE

only parts of the moon not yet mapped—less than half of 1 percent.

Apart from the two large hemispheres, the map and its 3,630 words of notes contain a wealth of information and lore, ranging from the number of known moons in our solar system (52) to the plan for the Apollo moon-landing flight. This stretches across the map's full width at the bottom, thus making it possible to show the earth, the moon, and the distance between them in true relative scale.

Assigned to make the diagrams showing the moon's phases, staff cartographer David L. Moore (page 242) spent many sleepless nights photographing the moon to assure complete accuracy in his drawings.

Other diagrams and notes show how the moon "nods" and "shakes its head," how it causes tides and eclipses, how it compares to the moons of other planets.

To visualize its true size—2,160 miles in diameter—look at the moon's disk drawn atop the United States. Las Vegas, Nevada, peers around one edge and Philadelphia, Pennsylvania, just shows on the other.

Another sketch lets you grasp the true magnitude of the moon's craters. It shows

our Grand Canyon dwarfed by Copernicus (above). By no means the largest crater, it compares to Yellowstone in size and could swallow the entire state of Rhode Island.

To give the map an intriguing border, we made it a sometimes serious, sometimes whimsical catchall of 163 names and terms related to the moon, moon lore, and space travel. The list includes astronauts, cosmonauts, spacecraft, scientists and rocketeers, lunar place names, technical terms, and such familiar Space Age expressions as A-OK, countdown, lift-off, and rendezvous.

U. S. and Soviet Space Heroes Honored

Our map border honors Gus Grissom, Ed White, and Roger Chaffee, the three astronauts who died on January 27, 1967, when fire swept their spacecraft during a test at Cape Kennedy. Grissom was one of the original team of astronauts, and the other six—Glenn, Shepard, Slayton, Carpenter, Schirra, and Cooper—also appear.

The late Yuri Gagarin, the first man in space, is there. So are his cosmonaut colleagues Popovich, Nikolayev, Titov, Leonov, and Valentina Tereshkova—the first woman

Copernicus equals Yellowstone

FOR DRAMATIC COMPARISON, the Society's cartographers have mapped here a large slice of the American West and an equal-size area of the moon, employing the same technique and style used for the supplement map, *The Earth's Moon*. The comparison reveals that the moon crater Copernicus, shown in part in the Orbiter photograph at left, just about matches in size our largest national park, Yellowstone. Journeying from Copernicus to the crater Ptolemaeus, a traveler would log 400 miles—the distance from Yellowstone to Denver, Colorado. Interestingly, the 12,600-foot-high rim of Copernicus actually towers higher above the crater floor than do the Rocky Mountains over Denver's mile-high plain.



in space. Even Laika, the Soviet dog that circled the earth, made the list.

Spacecraft named in the border include the Soviet Union's Lunik 2, first to crash-land on the moon; Zond 5, the first craft to make a circumlunar voyage and return safely to earth; Friendship 7, the capsule in which John Glenn became the first American to orbit the earth; and Ranger 7, our first successful lunar photo-reconnaissance vehicle.

Three great astronomers of the past, Hevelius (who in 1647 produced the first real map of the moon), Tycho Brahe, and Kepler, are among a who's who of men of science on the border. It includes such present-day space experts as Wernher von Braun, Bernard Lovell, Robert Gilruth, and the late Hugh L. Dryden, for 14 years a Trustee of your Society, and, until his death in 1965, NASA's top scientist.

On the lighter side are popular descriptions of the moon, literary allusions, authors, frag-

ments of nursery rhymes—even a comic-strip character, Moon Maid.

A puzzler, perhaps, is Wan Hoo. Who was Hoo? A rich merchant of Chinese legend who longed to visit the moon, he had himself strapped into a chair with 47 rockets fastened to its back. He held a kite in each hand, and his servants lighted the rockets. No one ever saw Wan Hoo again.

The Pill of Immortality comes from an ancient Chinese legend that the rabbit on the moon, shown in an inset on our map, keeps pounding away to make such a pill.

Cavorite? All of us might wish for a little of that, an antigravity substance dreamed up by H. G. Wells for a story, *The First Men in the Moon*, in 1901.

"I am Eagle!" That's what Gherman Titov exclaimed over the radio, exulting as Vostok 2 carried him around the earth on the second manned orbital flight.

And what color should we make our moon? Over the centuries our satellite has been variously described as red, golden, pale, gray, silver, even blue. For realism as well as beauty we decided to show it silvery-gray against the blue-blackness of night.

THE END

Additional copies of *The Earth's Moon* wall map may be ordered from Dept. 61, National Geographic Society, Washington, D. C. 20016, for \$1 each on paper, plus 15 cents postage, or \$2 on plastic, plus 30 cents postage; both are available rolled instead of folded. A companion wall map, *The Heavens*, showing positions of the planets through 1970, is also available at the same prices.

Atlanta, Pacesetter



City of the South

By WILLIAM S. ELLIS

National Geographic Staff

Photographs by JAMES L. AMOS



SPARKING A NEW ERA OF GROWTH, Atlanta builds skyward. Core of the boom is Peachtree Center: Antenna-topped Peachtree Center Building, left, connects via a 22-story-high aerial walkway to the Merchandise Mart behind the slender Gas Light Tower. Like a spacecraft come to earth, a revolving lounge caps the Regency Hyatt House.

WALKING ALONG Peachtree Street on a summer evening tinted yellow by fireflies, I stopped, looked around, and told myself that William Tecumseh Sherman was right about Atlanta.

Not—I hasten to add—because the Yankee general burned the city to a cinder on his march to the sea in 1864. I was simply recalling a little-known story told to me only a few hours earlier by Ralph McGill, famed publisher of the *Atlanta Constitution*.

"Sherman returned to Atlanta 15 years after the burning," Mr. McGill said, "and a young reporter for our paper named Clark Howell asked him why he had burned the city. Many years later, when he had become editor, Howell told me how the general took one of his hands in his own and, pointing to the palm, replied:

"'Young man, when I got to Atlanta, what was left of the Confederacy could be roughly compared to your hand. Atlanta was the palm, and by destroying it I spared myself much further fighting. But remember, the same reason which caused me to destroy Atlanta will make it a great city in the future.'"

"We Can't Live in the Past"

I walked on, feeling the truth of this prophecy on every side. Though the city was at rest, kerosene lanterns flickered beside gaping excavations; steel skeletons soared into a dark sky, awaiting the morning return of machines and men who would put Atlanta in even closer communion with its golden promise.

I had come to know Atlanta some 15 years ago, when it was still a relaxed Southern city on the brink of its destiny. Now I found the city caught up on a wave of development and growth, strengthening its role as a transportation hub, medical and educational center, financial capital of a large section of the country, and ballet-to-baseball sophisticate in culture and major-league sports.

Atlanta exemplifies the best of a new breed of thriving urban communities, touched by technology and stirred by the Air Age—cities that are making a growing impact on the Nation's economy and a deepening imprint on its character.

Today's Atlanta boils with activity. High above a downtown corner where I used to listen to the shrill admonishments of a tattooed evangelist, workmen pour concrete around the rib cage of a building under construction. Express buses to the new \$18,000,000 stadium line the curb of another block, siphoning clumps of sports fans from the sidewalk. In

the hotels, hordes of convention-goers do battle with the doors of packed elevators.

Marveling at the many changes led me to wonder about survival of the town's personality. Here, after all, was a city where a Dr. Martin Luther King, Jr., could rise to international fame fighting for civil rights, while a Lester Maddox was ascending to the governorship on a platform of strict segregation. And where else could Negroes and members of the Ku Klux Klan picket on the same street, while a Salvation Army band blared hymns half a block away?

"Atlanta's character has always been one of growth and progress, so there's no danger of that being lost," I was assured by Mayor Ivan Allen, Jr. (opposite, second from right). "Of course there's some nostalgia for the way things were, but we can't live in the past."

Responsibility for Atlanta's position as flagship city of the Southeast rests largely

Congenial partners in progress lunch at a Commerce Club directors' meeting. Atlantans consider the cooperation of business and political leaders the key to the city's development. From right: Frank M. Malone, president of Southern Bell Telephone and Telegraph Company, directs a major segment of the South's largest communications center. Ivan Allen, Jr., whose portrait hangs at center, serves his second term as mayor. Robert W. Woodruff, the retired president and now chairman of the Finance Committee of the Coca-Cola Company, built the Atlanta-born firm into a world-famous name. Gordon Jones presides over the Fulton National Bank that raised the first of Atlanta's modern skyscrapers in 1955. Department store magnates—Roland A. Maxwell, president of Davison's, and Richard H. Rich, chairman of Rich's, Inc.—have helped make the city a focus of retail trade.



with Mayor Allen and former Mayor William B. Hartsfield. Most Atlantans credit Bill Hartsfield, who held the office for 24 years, with guiding their city from the verge of bankruptcy to an enviable financial stability.

Atlanta Builds a Dynamic Image

Just before succeeding Mayor Hartsfield in 1962, Ivan Allen, as president of the Chamber of Commerce, engineered the spectacular success of "Forward Atlanta," a program aimed at selling Atlanta to the Nation as a good place to do business. The city advertises itself in leading business publications. For the most part, the sell is low-key, with only an occasional rise on a balloon of puffery.

The Forward Atlanta program will run until at least 1970. But golden prosperity is already upon the city. New jobs created since 1961 number nearly 160,000, for a gain of 43 percent, a sharper climb than that of any other

major U.S. metropolitan area. More jobs mean more people, and the population rise since 1960 exceeds 25 percent—to a total for the greater city of 1,272,000. Bank deposits and housing starts are up more than 50 percent in seven years, and apartment units have almost doubled. Atlanta leads the South as a distributor of goods and services.

"More than 150 delegations from other cities and states have come to Atlanta to study the city's growth," a leader in the Forward Atlanta program told me. "We had Philadelphia and New Haven here the same day."

Members of the delegations came to observe, and they saw the dozens of new office buildings and manufacturing plants and warehouses. They saw a merchandise mart offering two million square feet of exhibit space, a \$13,000,000 cultural center, and a \$10,000,000 civic center—all spanking new. They saw an \$18,000,000 hotel that's like no



other hotel, and a 41-story bank building that towers over all other commercial structures in the Southeast (pages 280-81).

Lo, they even saw a remarkable new bus terminal, designed to carry a 2,000-seat theater on its roof.

More than 400 of the Nation's 500 biggest industrial corporations now maintain operations in Atlanta. With them came an influx of college-trained young men accustomed to efficiency. Some of those transferred from the North arrive with apprehension, fearful they are about to drown in a sea of collard greens. They envision Southern summers of thick, hugging heat, with relief available only in the flick of a bamboo fan imprinted with the name of a funeral parlor.

The collard-greens hugaboo is dismissed with the first visit to one of the city's many excellent restaurants. The newcomers quickly learn, too, that the weather borders on the ideal. Atlanta sits on the Piedmont Plateau at an elevation of 1,050 feet, third in altitude after Denver and Phoenix among U. S. cities of more than half a million (map, page 252). Atlanta's physical geography, in fact, is unique: When it rains, the runoff on the west side of downtown Peachtree Street is ticketed for the Gulf of Mexico by way of the Chattahoochee and Apalachicola Rivers, on the east, for the Atlantic via the Ocmulgee and Altamaha.

Courtesy Sweetens Life's Routine

What impresses newcomers most, however, is the graciousness of Atlantans, an endearing gentleness of speech and manner. Courtesy persists as a characteristic trait, unruffled by the busy pace of the city.

Atlanta policemen fit the mold. I once sought directions from a traffic officer and was told, "Doggone it, I can't remember right off where the place is, but we'll find it. You come with me." We went into a drugstore, where he consulted a map; then, pointing me in the right direction, he said, "You come on back if you can't find it, you hear?"

And this from an elderly woman clerk in a department store: "Now you let me put a

pretty ribbon around this package. Goodness gracious, you can't take your wife a nice present like this stuffed in an old brown poke!"

The air traveler sees Atlanta as a grand design in a brilliant tapestry of piney woods and Georgia clay. In spring the color carries into handsome suburban areas, with their patchwork quilt of flaming azaleas, camellias, and dogwood (pages 274-5). With no mountains or large bodies of water to confine it, the city is free to sprawl in all directions—which poses a challenge for its central core.

Municipal Showcase: Peachtree Center

Downtown Atlanta is undergoing an imaginative face lifting that carries the promise of a new concept in urban living. Showcase of this effort to keep downtown bustling and vital is Peachtree Center, a cluster of buildings destined to become a city within a city.

Peachtree Center mirrors the vision of John C. Portman, Jr., a gifted young Atlanta architect driven by impatience. His first building in the complex was the 22-story Atlanta Merchandise Mart, opened in 1961; a recent expansion made it the second largest such facility in the Nation, after the Merchandise Mart in Chicago. He followed that with three office towers, a hotel, and a bus terminal. Soon to come: a 70-story skyscraper.

Talking in his office on the 21st floor of the Peachtree Center Building, Portman was full of infectious enthusiasm for the promise of cities (page 254). "As architects, we have been building buildings, single buildings. We have to do more if we are to solve the problems of our complex society. What we are doing at Peachtree Center is developing coordinated urban units.

"There will be 45 acres where you can walk without ever getting on the same level as an automobile," he continued. "We're planning gardens and galleries and restaurants, museums and theaters, places to live and work—everything. This is the grand scale; this is what cities are all about."

When Peachtree Center is completed, a person will be able to live, work, shop, play,

Astonishing the eye from every angle, the Regency Hyatt House explodes in patterns of form and color. Sunlight filtering through a 22-story-high Plexiglas ceiling floods the lobby, designed to the last detail by Atlanta architect John C. Portman, Jr. (page 254). Like hanging gardens, red-carpeted balconies overlook a Danish "sidewalk" cafe, left, and floor tiles reminiscent of the cobblestones of a European village square. Festive glass-bubble elevators shoot up and down like toy rockets. Above a circular lounge, a petaled dome hangs by a single steel cable. Fountain flowing in golden tubes adds the music of rushing water.



and worship without leaving the \$175,000,000 complex—and do it all on foot without walking more than seven and a half minutes at a time from any one unit to another.

"The average person will walk for seven and a half minutes rather than bother to take a car or a bus," Portman explained. "So that's the limiting time factor in locating the units. You see, what we're trying to do is to turn this thing back to a man on foot in a village, but a village in the center of the whole throbbing heart of a great city" (downtown map, opposite).

Hotel Lobby Boasts a 70-foot Fountain

From Portman's office window I looked across Peachtree Street to the Regency Hyatt House, the young architect's most creative work. Viewed from the outside, the hotel holds little hint of what's in store for the person about to enter the building for the first time. The entranceways are dark and confining. But then: Space expands overwhelmingly in the lobby, soaring to the heavens in a 22-story sunlit atrium. Glass-bubble elevators, festooned with rows of lights, streak up and down the columns of the great court (preceding page). Water flows musically within the tubes of an unusual 70-foot fountain. A massive 13-ton, parasol-like cover over an elevated cocktail lounge in the lobby hangs suspended from the ceiling by a single cable.

Topping it off, a lounge slowly revolves on the roof. At night its Plexiglas dome glows a soft blue, adding a decorative scoop of marzipan to the city's skyline.

The Peachtree Center buildings are connected by pedestrian passageways above street level. The Merchandise Mart and one of the office towers are joined by a span 22 stories above Peachtree Street (page 268).

Though Atlantans by now have learned to accept a bridge over their beloved street, many did not take kindly to the news at first. Older residents still like to remember a Peachtree Street lined with handsome homes, a street for leisurely strolls and the tipping of hats to gracious ladies. No signs citing parking restrictions cluttered the curbs—only an occasional prophecy, hand-lettered and tacked to a tree, that "The Day of Judgment Is Near!" The idling motors of trolley cars chanted "lu-lu-lu-lu," while thirsty kids clambered aboard the rear platforms of ice wagons in search of refreshing chips.

Atlanta in its infancy was something else again. "It more closely resembled a frontier town of the Old West than a moonlight-and-



Gift of geography places Atlanta, capital of Georgia, in the heart of the Southland—a natural hub for transportation, communications, and industry (top). Six rail systems, three interstate highways, and an international airport, fourth busiest in the Nation, serve 1,272,000 people in the metropolitan area (above). Narrow downtown streets (opposite) date from the city's earliest days.

magnolia town of the Old South, primarily because it was created as a railroad center," Franklin M. Garrett, director of the Atlanta Historical Society, told me. "It was a small town with more saloons than churches."

For all its rich history, Atlanta is a young city. Less than 150 years ago the land on which it stands belonged to Creek Indians. In 1836, 15 years after the Creeks ceded the land to the State of Georgia, plans were pushed to establish a railroad to connect the nearby Chattahoochee River with the Tennessee. An Army Engineer from New Hampshire stuck a stake in the ground to mark the southern terminus of the line, and in doing so ordained that bit of red clay to be the birthplace of Atlanta.

"The destiny of Atlanta was pegged from the start to be a transportation and distribution center, and that's what it still is," Franklin Garrett continued. "By 1860 four railroad lines met in the city. It was a noisy place, picturesque but noisy."

Through the circumstances of its birth,



Twentieth-century troubadours, guitar players from Georgia State College entertain a lunch-hour crowd with folk-rock, soul, and pop music during the Dogwood Festival (page 275). They perform at Five Points, the “Times Square” of Atlanta.



ESTABLISHING TEST CENTERS AND ASSOCIATES © R. S. L.



Future scientist, Atlanta University graduate student Walter Manigault investigates toxins produced by soil fungi. He received his master's degree in biology last year. Founded for freedmen in 1865, A. U. is the graduate and professional school of Atlanta University Center (page 261).

"Cities can be fun," says John Portman, who designed Peachtree Center, a complex of office buildings, hotel, restaurants, shops, and sculpture-ornamented courtyards (pages 268-9). Aerial walkways separate pedestrians from auto-filled streets. Upon completion, the 45-acre city-within-a-city, including apartments, theaters, and museums, will place all facilities within easy walking distance. A practical dreamer, Portman retains part ownership to ensure adherence to his ideas.

Voice of the southern liberal, Ralph McGill writes a daily column syndicated throughout the Nation. As publisher of the *Atlanta Constitution*, he threw the moral force of his newspaper behind successful desegregation efforts in the early 1960's. Now he stresses improving schools and job opportunities for all. "We Atlantans have come a long way in assuring the rights of every man," he says, "but we have a way yet to go."





With a hand in the new Atlanta, construction man Ed Morgan works with a concrete-flooring crew high on the Trust Company of Georgia building. By attracting business, metropolitan Atlanta each year creates more than 26,000 jobs.



EDUCATIONAL © A.S.A.

In the tradition of old Atlanta, railroad engineer Zollie Cole brakes his engine in a Louisville and Nashville yard. Born as a rail terminus, Atlanta became the South's Civil War transport hub; that was why Union Gen. William T. Sherman leveled the city. Today it again thrives as a rail center.

Atlanta was first called, alas, "Terminus," and later "Marthasville" (after the daughter of a Georgia governor). As Atlanta (a word coined in 1845, in an attempt to convey the feminine of Atlantic), the town entered the Civil War decade of the 1860's in rowdy good health. The population was almost 10,000.

At that time 3,800 homes stood in Atlanta. Only 400 of them would survive the crowning drama in the city's history. That drama began in July 1864, with the approach of Gen. William Tecumseh Sherman's army.

"Sherman spearheaded his drive on Atlanta from Chattanooga," Mr. Garrett said. "He came down the Western and Atlantic Railroad line and later used the railroad as his supply line from the North."

As Sherman's men drew closer, Confederate Gen. John B. Hood ordered his forces to engage the Federals at Peachtree Creek, just north of what is now downtown Atlanta (map, page 252). Hood's casualties totaled 2,500.

"After the victory," Mr. Garrett continued, "Sherman attempted to get around to the east of the city to break the Georgia Railroad. This resulted in the Battle of Atlanta."

The first Union shell fell on the city, killing a child. The famous siege had begun. Artillery fire reached its worst intensity on what Wallace P. Reed, a 19th-century historian, termed "that red day in August," when "all the thunders of the universe seemed to be blazing and roaring over Atlanta."

Confederates Also Fed the Flames

With three of its rail lines cut and the fourth in enemy hands, Atlanta surrendered on September 2. The city was already three-quarters destroyed, partly as a result of actions by the Confederates. For example, the blazing holocaust usually shown in pictures depicting the battle came about when retreating soldiers blew up 81 freight cars of explosives and ammunition.

The Union Army, having executed an order to destroy all buildings of possible use to the enemy, marched out of the city on the morning of November 15, headed for the sea. Atlanta lay in ashes.

One hundred and four years later, I stood on St. Paul Avenue, in southeast Atlanta, and witnessed a scene full of grim irony. A 110-year-old former plantation mansion, one of the few structures to escape the torch of Sherman's army, had mysteriously caught fire. That set me to wondering why this vacant, vine-throttled house had survived the battle. One story has it that General Sherman,





LARGEST AIRCRAFT IN THE WORLD, the C-5 Galaxy takes to the air for tests, fired by four jet engines blasting 164,000 pounds of thrust. Built by the Lockheed-Georgia Company at suburban Marietta, the sky-filling cargo plane—246 feet long with a 223-foot wingspan—would nearly cover a football field. Its cavernous hold can carry two helicopters, two tanks, and assorted trucks and trailers; their crews ride in an upstairs passenger compartment that seats 75. Twenty-eight wheels enable the 364-ton behemoth to take off from an unpaved surface; with a 100,000-pound payload, the craft can fly 6,330 miles nonstop. Plans call for delivery to the Air Force in June and production of a commercial-freighter version by 1972.





Poised in an abstract pattern of modern dance, Claudie Simmons practices the wide-ranging repertoire of the Atlanta Ballet. Forty years ago choreographer-teacher Dorothy Alexander founded the company, America's oldest civic ballet. Now the internationally recognized group performs, teaches, and tours year round.

though apparently not a Mason himself, ordered that it be spared when his soldiers found Masonic symbols there.

Of all the pictures painted and words written about Atlanta's Civil War past, only two of the efforts are invested with seemingly everlasting popularity. One is the famous Cyclorama, a painting 50 feet high, 400 feet in circumference, and weighing 18,000 pounds. The monumental work is housed in a marble building at Grant Park (not *that* Grant, but early railroad tycoon Col. Lemuel P. Grant).

Completed in 1885-86 by a group of German artists, the Cyclorama tells the story of the Battle of Atlanta with such three-dimensional impact that the viewer feels drawn into the action. Sound effects lend a crack to the rifles and a muffled moan to the wounded.

The recorded narration traces the battle from start to finish, while music—"Dixie" or "The Battle Hymn of the Republic," depending on which side has the upper hand at the moment—rumbles through the room. I came away from the painting with a stark, almost numbing realization of the tragedy of the Civil War.

Best Seller Sells On and On

Even closer to the heart of long-time Atlantans is "the book." Margaret Mitchell wrote it, Hollywood filmed it, 35 countries published it, and millions of readers bought it. Even now, more than 30 years after it first appeared, *Gone With the Wind* holds a secure place in the public eye.

During lunch at Atlanta's venerable Capital City Club, I asked Stephens Mitchell,



PHOTOGRAPHS BY JAMES L. MOSE © R.C.L.

"Charge!" Trumpet man leads a baseball crowd in an old football cheer as the Atlanta Braves rally against the San Francisco Giants last May in Atlanta Stadium. Completed in April 1965, the arena rose in only 51 weeks at a cost of \$18,000,000. The Falcons football team and the soccer Chiefs also make the stadium their home.

brother of the late author, if business involving the book's literary rights still consumed much of his time.

"Just last week we had spirited bidding by some Scandinavian groups for rights to publish new editions of the book," he said. "Our Yugoslavian publisher recently put out a Hungarian edition for Hungarian refugees living in that country. A musical dramatization of the book is being written. So there's still enough work to take up most of my time."

Sales of the book, including all foreign editions, exceed 15,000,000 copies. The filmed version, which had a memorable premiere in Atlanta on December 15, 1939, is always playing somewhere in the world.

But only in Atlanta can the impact of the book be encountered at almost every turn.

For example, I walked across Margaret Mitchell Square, bought a ticket, and sat through a re-release of *Gone With the Wind* at the same theater where it had premiered. I then had a leisurely dinner at a restaurant called "Pittypat's Porch." In the novel, Pittypat is the fluttery aunt of heroine Scarlett O'Hara.

Finally, on my way back to the hotel, I purchased a local newspaper which mentioned that a seven-year-old Atlantan named Rhett Butler Spivia had fully recovered from a case of—what else?—scarlet fever.

Druggist Concocts a Soft-drink Empire

John S. Pemberton isn't as well known as Scarlett O'Hara, but his impact on Atlanta is no less great. In the 1880's "Doc" Pemberton, a druggist, mixed some water, sugar, caramel,



AP/WIDEWORLD

In any language, Coca-Cola stands for the world's most famous soft drink. In 1886 an Atlanta druggist invented the formula; now 39 plants around the world produce the concentrate, minus one top-secret ingredient, 7-X, which comes only from the Atlanta headquarters. To ensure uniform taste, Coke bottled for Germans, Arabs, Thais, Mexicans, and Japanese here undergoes tests by technician Florence Page.

and a few other things to produce a syrup called Coca-Cola.

In the first year of production, Pemberton sold 25 gallons of the syrup, much of it mixed in a three-legged pot in his back yard. By 1891 another Atlanta druggist, Asa G. Candler, had acquired full ownership of Coca-Cola, and the syrup began to flow. And flow and flow, until today more than 95 million servings of the beverage are consumed in cups and bottles daily in 138 lands.

Pemberton received \$50 in revenues for his first year's production of 25 gallons. In 1967 the company's annual sales first reached the billion-dollar level.

Direction of this carbonated phenomenon emanates from a new 11-story building on Atlanta's North Avenue. There I saw white-jacketed experts at work to preserve the unique taste of Coke (above)—a taste as familiar to a tinsmith in Tanzania as to a postal worker in Illinois.

Red-hot radome—the radar shield of a missile—leaves the furnace at a ceramics research laboratory in the High Temperature Materials Division of Georgia Institute of Technology. The nose cone of fused silica, developed for the Air Force and Navy, protects a missile's sensitive radar from rain and heat, yet permits the passage of signals.



REDACTEDS ABOVE AND ATTACHEDES © R.S.L.

Showers by sparks, welders assemble a station wagon, one of 1,000 automobiles that roll off the lines daily at Atlanta's Ford Motor Company plant. In 1915 Ford opened operations here, producing 50 Model T's a day. General Motors followed with assembly plants. Today in Atlanta some 1,650 industries manufacture more than 3,500 products, ranging from aircraft to stationery.



Search for talent takes a representative from International Business Machines Corporation to a career conference at Atlanta University Center last fall. Some 60 companies and government agencies participated. Ray Henry answers questions about IBM opportunities.

To facilitate exchange of teachers, courses, and equipment, the center links six campuses—Atlanta University, Morehouse, Spelman, Clark, Morris Brown, and the Interdenominational Theological Center.







AP/WIDEWORLD



On land and lake, racing fever grips Atlanta

AUTO AND BOAT RACES, two of the Nation's most popular sports, attract participants and spectators to new facilities in the metropolitan area. During a hectic 35-second pit stop at the Atlanta 500 last March (above), stock-car driver Buddy Baker of North Carolina takes on fuel, new tires, and a drink of water. Some 80,000 fans watched 44 drivers compete for \$83,000 in prizes in the grueling four-hour endurance test. Second only to horse racing in popularity, auto racing draws 40 million spectators a year in the United States.

With spinnakers ballooning, Flying Dutchman sloops reach off the wind on Lake Sidney Lanier during the Wooden Shoe Regatta last May. Winning sailors from this class went on to the U.S. Olympic trials. So many sailing enthusiasts come to Atlanta that the city claims the title of "inland boating capital of the world." Named for the Georgia poet, the lake, a 10-year-old reservoir on the Chattahoochee River, provides recreation and water for the city.

All my life, it seems, I have heard about a secret ingredient in the formula for making Coca-Cola. "Is it true?" I asked an official of the company.

"It's true," he replied. "Coke contains six well-known ingredients—and one secret one. Usually not more than two people at one time know the full formula."

The seventh ingredient is prepared behind closed doors in what is known as the 7-X Room. I wasn't allowed in; frankly, I'm glad, because I like to think that behind those doors there sits a beautiful lady all in white, waving a wand and chanting incantations to raise a great fountain of 7-X from Doc Pemberton's old three-legged pot.

Atlantans regard Coke with an affection that approaches passion. A local zoo once housed four elephants named Coca, Cola, Delicious, and Refreshing. Visitors to the city are always urged to tour the suburban area where the Coca-Cola millionaires built their homes—imposing mansions of an architecture goodheartedly described as "rococola."

Company Responds to Civic Needs

The Coca-Cola Company returns the affection with liberal endowments to colleges, universities, and other institutions in Atlanta. Equally important, the company plays an active role in the joint business-government campaign to meet the problems of the city.

Under the National Alliance of Businessmen's program to provide jobs for so-called hard-core unemployables, Coca-Cola is among the firms recruiting help off ghetto streets.

"Even if one of these people drops off the job three times, we go out and bring him back each time," said J. Paul Austin, the young and forceful president of Coca-Cola. "He is assigned to a veteran worker who looks after him. After a while he finds that he, too, is eligible for job advances and salary increases."

Unemployment, slums, a society fragmented along racial lines—Atlanta, for all its sparkle, is not entirely free of these problems. Although no longer racially segregated, the city bears some scars from the past.

Many expressions for a single emotion—dismay. Football rooters at Morris Brown College react when a rival team threatens to score. Part of Atlanta University Center, the school offers its 1,400 students small-campus life with large-college facilities.

Negroes comprise 45 percent of the 506,100 persons who reside in Atlanta proper, and many live in sections where the musky odor of decay weighs heavy on the air—places with names such as "Cabbagetown" and "Lightning." Urban renewal and a Model Cities program are working to erase much of this.

Atlanta started moving long ago to eliminate racial inequalities. The peaceful desegregation of its schools in 1961 set an example of good sense and dignity for other cities to follow. Even before that, men such as Ralph McGill and Bill Hartsfield were steering the city toward the inevitable break with rigid segregation.

"Around 1940 we on the *Constitution* began to try to educate the people," McGill told me as we sat in his book-clogged office (page 254). "For example, we called then for Negroes



on the police force. It's all been a slow process."

Now nearing his fortieth year as a newspaperman in Atlanta, Ralph McGill can take much credit for the city's forward look in these matters. As an author, syndicated columnist, and winner of a Pulitzer Prize, he speaks with a long-time voice of reason in the South he loves.

In his writings and actions, Ralph McGill did not let his fellow Atlantans forget that a young Negro minister, a graduate of the city's Morehouse College, had brought great honor to the community by winning the Nobel Prize for Peace.

Today many Atlantans—including whites—revere the memory of Dr. Martin Luther King, Jr., who died in the spring of 1968 at the hand of an assassin. Even those who opposed his efforts to achieve racial equality

concede that no Atlantan in this century had a greater impact on the Nation.

Since Dr. King's death, Atlantans have expressed concern over a growing militancy among young Negroes. Nearly everyone I spoke to concerning the problem suggested that I contact the Reverend William Holmes Borders, pastor of the Wheat Street Baptist Church for more than 30 years.

I found Dr. Borders in his parsonage, deep in a frame-home neighborhood where householders plant flowers in coffee cans and set them out on porch railings.

"We Negroes had three strikes and out against us before we could even pick up our bat and come to the plate," he told me. "So it shouldn't be hard to understand these pressing demands of the young people."

Born in rural poverty himself, Dr. Borders

EXTENDING BY LINE 1. 1968 © NATIONAL GEOGRAPHIC SOCIETY





WILLIAM H. HARRIS © NATIONAL GEOGRAPHIC SOCIETY

Rage triggered by remote control, a rhesus monkey reacts to electrical impulses transmitted through electrodes painlessly implanted under his plastic cap. His companion may next receive stimulation to the brain area that affects sexual behavior. The project at Yerkes Regional Primate Research Center, part of Emory University, investigates which parts of the brain control different emotions and how a stimulated animal reacts to its fellows.

participated vigorously in the campaigns to desegregate Atlanta's public facilities. He views the city's racial problems with a mixture of apprehension and optimism.

"What we need to do now," he said, "is to make sure every child gets a full education, including college. It should be compulsory, even if it costs a trillion dollars a minute.

"I'm hopeful, though, because I know Atlanta has a beautiful spirit. And I know that it is far ahead of other Southern cities, and many Northern ones also, in trying to understand the problems of Negroes."

In at least one respect, Dr. Borders is not too happy with the thrust of social change. "A white pastor tried to talk my leading soprano into joining the choir of his church," he said, smiling. "That's not integration. That's robbery!"

Atlanta departs from the social mold of the Old South in other ways as well. Consider, for example, the city's 21 colleges and universities, including the Atlanta University Center. The latter, the Nation's largest complex of schools devoted primarily to Negro education, will soon be strengthened by a 50-million-dollar development program.

Small Colleges Form Big Academic Team

Member institutions of the center include Atlanta University, Clark College, Interdenominational Theological Center, Morehouse College, Morris Brown College, and Spelman College (preceding pages and 254).

I visited the 145-acre center near downtown Atlanta, and strolled its pleasant, shady campuses. Students—both Negro and white—spoke to me with enthusiasm about this



STUDY IMAGE, ACTUAL SIZE

Telltale glow catches the culprit (above) during virus studies at the National Communicable Disease Center. Suspecting a case of rabies from a fox bite, researchers combined a rabies antibody with a fluorescent dye and added it to a specimen from the fox's salivary gland. When the antibody stained an infected area yellow-green, the disease was quickly identified.

In this fluorescent-antibody technique, technologists work under red light that permits them to see without affecting use of ultraviolet microscopes (right). The center trains 14,000 health officials annually in disease-control methods.



FLUORESCENCE (RIGHT) BY JAMES L. AMOS, AND COCHAINED BY FREDERICK A. BURRITT © W.E.L.

unusual experiment in cooperative education.

"We have the advantages of a large university," one senior coed told me. "All these library facilities, for example, and a wide range of courses. Yet we get the individual attention and the sense of belonging that you'd find at a small college."

A song with spirited lyrics has brought far-reaching fame to one Atlanta institution of higher learning. Though less renowned by its formal name, Georgia Institute of Technology is the Georgia Tech whence come Ramblin' Wrecks, or "Recks" as the students spell it. Opened 80 years ago, the state-supported engineering and scientific school today challenges 7,950 scholars with a no-nonsense education; here the slide rule is scepter, logarithmic tables are articles of faith.

"The work load is much greater here than

at most schools," said Robert B. Wallace, Jr., director of information and publications.

At the time of its founding, Georgia Tech drew more financial support from the city of Atlanta than from the state. The relationship remains close, having survived a period of strain many years ago when a businessman said he was glad Tech located in Atlanta because the city needed a lot of blacksmiths.

Tech is deep in research. In one of the buildings on the 230-acre campus, I saw scientists working with a scanning electron microscope, an \$80,000 instrument that for the first time allows researchers to see three-dimensional pictures of cells and chromosomes.

Dr. Reiner J. Gerdes, research assistant professor of chemical engineering, told me that the microscope can magnify up to 100,000 times. He trained the instrument on





an ordinary sheet of paper, and the picture projected on the screen was so detailed that I could see the separate mineral compounds—Georgia clay, for example—used in the papermaking process.

Photographs of cancer cells already have yielded valuable new information. "This instrument," Dr. Gerdes said, "is going to revolutionize many areas of medical research."

Prolate Spheroid Attracts Fall Throngs

To Atlantans, the presence of Tech right in the heart of their city means most of all a beloved, violent spectacle on fall Saturdays at Grant Field. Again, Atlanta is not that forgiving; the name is for Hugh Inman Grant, son of a wealthy Atlantan. Even with the new attraction of the Falcons, a professional team, Atlanta maintains a devotion to college football in general and Georgia Tech in particular.

The first of only four head coaches in Tech's history was the legendary John Heisman, for whom the Heisman Trophy is named. In a book on Georgia Tech, Bob Wallace writes of Heisman, "On the opening practice day he would hold up a football and ask the squad, 'What is it?' Before anyone could open his mouth, Heisman had answered his own question: 'A prolate spheroid—that is, an elongated sphere—in which the outer leathern casing is drawn tightly over a somewhat smaller rubber tubing.'"

Only at Georgia Tech are pigskins dressed out in such scientific finery.

Among Atlanta's leaders in the sciences is Emory University, in the beautiful Druid Hills section of the city. With some \$10,000,000 in grants, the university's vast Woodruff Medical Center last year was involved in nearly 200 research projects in health and related fields. They ranged from investigating sleep habits of cats to the use of temperature control as a means of destroying cancerous tumors.

One division of the university is the Yerkes Regional Primate Research Center, the oldest and best known among the Nation's major scientific centers for medical, biological, and psychological study of the great apes and monkeys. Here I watched Dr. Bryan W. Robinson activate electrodes implanted in the brains

"Renaissance," a free-form sculpture by Robert Helmsmoortel, symbolizes Atlanta's renewal. Fisheye lens catches the Peachtree Center Building, left, the nearly complete top of Peachtree Center South, and the aerial walkway high above Peachtree Street.

PHOTOGRAPH BY JAMES L. WHITE © 1984





of rhesus monkeys to set off an amazing display of behavioral control (page 266). When he wanted the monkeys to fight, he manipulated the proper dials and they fought. He made an aggressive male monkey submissive. He made a submissive male aggressive, even to the extent of intimidating a dominant male—rare behavior for monkeys.

"We are trying to determine if we can increase or decrease the adaptive capacity of the brain," Dr. Robinson explained. "Can we increase the rate whereby animal—thereby man—can learn? Can we increase the ability of animal, and man, to overcome threats with which he cannot normally cope? These are some of the answers we are after."

Center Trains Disease Detectives

Close to the Emory University complex stands the National Communicable Disease Center, a division of the U. S. Public Health Service that functions at times as a disease detective agency (page 267). The center concerns itself with surveillance, protection, and control. And with statistics—like the fact that the United States recorded its last case of smallpox in 1949, and the fact that, from 1957 to late 1968, 29 cases of bubonic plague occurred in the country.

Epidemiologists trained at the center fan out across the country to track down the sources of epidemics. When everyone gets sick after eating potato salad at a church picnic, chances are that an Atlanta-trained member of EIS, the Epidemic Intelligence Service, will uncover the information that the food had lain in the hot sun for several hours.

As home for so many colleges and universities, Atlanta is a city steeped in the fine arts. The Metropolitan Opera first sent a company to Atlanta in 1910, and its appearance each year highlights not only the city's musical calendar but the bustling social season as well.

In October 1968, the city dedicated the Atlanta Memorial Arts Center, a \$13,000,000 colonnaded building erected in memory of 122 Atlanta art patrons killed in 1962 when their chartered plane crashed in Paris. The

Gracious manner of the Old South lives on at the Bal de Salut, Atlanta debutantes' June charity ball at the Piedmont Driving Club in Piedmont Park. Constance Wright, left, and Sena Madeline Wright, escorted by Thomas Gilliland, stop for a photograph during their formal promenade. The club dates from the era of fine driving horses.

PHOTOGRAPH BY JAMES L. HODGE AND DEAN R. WOOD © 1969

French Government honored the memory of the victims by giving a six-foot-seven-inch bronze casting of Rodin's "L'Ombre" (The Shade) to the center (pages 278-9).

Hospitable Home for Artists and Patrons

Under the big roof of the center on Peachtree Street there is something for everyone interested in the arts: the High Museum of Art (including a collection of Old Masters); Atlanta School of Art; the Atlanta Symphony Orchestra under Robert Shaw's direction; and the Atlanta Municipal Theater, Inc., which includes ballet, opera, repertory thea-

ter, and children's theater. The center houses a symphony hall with 1,848 seats, an 868-seat theater for ballet, plays, and opera, and the intimate Studio Theater with only 200 seats.

Instrumental in making the center a reality was Richard H. Rich, a name synonymous with Atlanta's growth in recent years (page 248). Under his leadership, the Atlanta Arts Alliance, the center's founding body, spearheaded drives to finance the facility.

"We [Atlanta business leaders] got together one day, and someone said the city needs more cultural activities," Rich recalled.

"So we raised \$6,500,000."



ESTABLISHED BY JAMES L. ANDERSON, JR., N.C.A.A.

"Oh freedom, oh freedom!" Singing Atlantans march last May 9 in support of the Poor People's Campaign. Their sign honors the Reverend Martin Luther King, Jr., Atlanta-born civil rights leader, who was assassinated five weeks earlier. Using nonviolent demonstrations and economic boycotts, Dr. King helped desegregate public accommodations in Atlanta in 1961; three years later he won the Nobel Peace Prize.

Overcoming a widow's grief, Mrs. King continues her husband's work. She waits to address a Poor People's Campaign benefit at the Civic Center. Dr. King had planned the national campaign to help the disadvantaged, both black and white, by making visible "the island of poverty in our sea of affluence."

Dick Rich is chairman of the board of Rich's department store, which, like Coca-Cola and *Gone With the Wind*, is an Atlanta institution. Opened in 1867 as a dry-goods store in a building of rough-hewn lumber, Rich's is now the largest department store south of New York and east of the Mississippi River. Annual sales exceed \$170,000,000.

"My grandfather started the business," Dick Rich told me as we walked through the huge store on Broad Street. "We operate on the theory that 95 percent of our customers are honest and that it isn't fair to discommode the 95 percent in order to identify the 5 percent."

For Rich's, the theory has special implications. For example, returns are accepted without question or red tape; even purchases made at other stores are accepted for exchange at Rich's. During World War II, the store gave refunds on hundreds of pairs of defective nylon stockings even though it didn't carry the brand. Another exchange involved a pair of women's shoes—purchased 30 years earlier.

On one visit to the store I noticed an elderly woman sitting on one of the sofas on the mezzanine floor. I returned several days later and saw her again, on the same sofa. I learned







Milky way of flowering dogwood shimmers above Claire Drive near Emory University; each April hundreds of residential streets burst into bloom. Celebrating the spectacle of spring, Atlanta stages a week-long Dogwood Festival including evening tours past lighted trees and homes, concerts, fashion show, benefit ball, and parade (below).



PHOTOGRAPHS BY NANCY SMITH FOR NATIONAL GEOGRAPHIC SOCIETY

Vivacious Georgia belle graces a float in the Dogwood Festival Parade. Nancy Smith represents Georgia forestry in the procession along Peachtree Street. Atlanta's main avenue gained fame in *Gone With the Wind*, the best-selling Civil War saga by Atlantan Margaret Mitchell. Since its first printing in 1936, the novel has been published in 45 countries, the movie based on it still draws capacity crowds.

that she comes in almost every day—been doing it for years—and sits there for hours, sewing and greeting all her friends. She even brings her lunch. Rich's, of course, wouldn't think of asking her to leave.

Dick Rich and other business and civic leaders are now directing their efforts to building a rapid-transit system in Atlanta. Voters last November rejected a proposed 40-mile, three-quarter-billion-dollar system, and proponents are busy analyzing the reasons for the setback, convinced that a properly revised plan will win enthusiastic approval.

70 Miles an Hour Under Peachtree Street

Several miles of line would of necessity go underground, including a stretch through the heart of downtown Atlanta under Peachtree Street. Electrically powered rail cars would travel 60 to 70 miles an hour.

Mayor Allen is among those pushing hard for rapid transit. "We cannot accommodate any more traffic on our existing street patterns," he emphasized to me. "And there's not enough money on God's green earth to change the street patterns in Atlanta. The only solution is a mass-transit system or additional expressways."

Atlanta began constructing urban expressways before the Interstate Highway System was started.* A motorist approaching from any direction can drive through the city on a super-highway. Downtown, a few blocks from where the golden dome of the State Capitol forges spears of fire from the glare of the sun, six legs of the Interstate Highway System converge in a great sheepshank knot of ramps (pages 280-81). And around the city, construction of a circumferential highway nears completion.

Atlanta's airport, like its streets, also carries a full-capacity load. Fourth busiest in the Nation in passenger enplanements, the airport has already outgrown its \$20,000,000 terminal building, completed only eight years ago. With plans for a new terminal and expanded runways now on the board, attention is turning to the likely need for a second airport site by 1980.

In March of 1968 the biggest airplane in the world emerged from a hangar at the Lockheed-Georgia plant at Marietta, 16 miles from Atlanta (pages 256-7). Several months later I watched this colossus, the 364-ton C-5 Galaxy, return lightly to earth after a five-hour test flight. My request to go aboard was denied because workers were swarming over the craft, checking results of the tests. A Lockheed official invited me to examine the mock-up instead.

*See "Our Growing Interstate Highway System," by Robert Paul Jordan, NATIONAL GEOGRAPHIC, February 1968.





(SCULPTURES BY JAMES L. ARON (LEFT) AND STEPHEN LANDO © R.E.A.)



Vanquished in life, eternal in memory, leaders of the Confederacy ride on in this monumental sculpture taking shape at Stone Mountain Park, 15 miles east of Atlanta. Confederacy President Jefferson Davis and Gen. Robert E. Lee ride ahead of Gen. Thomas J. (Stonewall) Jackson, hats over their hearts as if in final tribute to their fallen flag. The figures fill a 1.3-acre niche that looks like a postage stamp on the side of Stone Mountain, the world's largest isolated block of granite (left). Begun 46 years ago, work on the memorial was halted in 1928 for lack of funds and resumed in 1964; the carving will be completed later this year.

Chief carver Roy Faulkner, center above, wields an industrial jet torch which blisters the hard stone and blasts it away. Water cooling the torch darkens the shoulder of Lee's horse, Traveller. The carver can make changes in this relief simply by cutting deeper into the rock. As a result of a recent alteration, Davis's right hand now holds his hat by the brim.

The 3,800-acre park offers paying visitors campsites, boating, a motel, scenic railroad, ante bellum plantation, and a cable-car ride to the top of the mountain, 825 feet above the plain.

A feeling of being lost in a warehouse gripped me as I walked inside. "How big is it?" I asked.

"Big enough to put six Greyhound buses on the main cargo deck," the Lockheed man replied.

The C-5, built for the Air Force, has a wingspan of 223 feet. The tail section reaches 65 feet—almost six stories—into the air. The Government ordered 58 planes, with an option to buy 57 more. I asked about the cost.

"That depends on the number ordered. The

L-500, a somewhat larger commercial version, will carry a price tag of about \$22,750,000."

The \$4,000,000 weekly payroll of Lockheed-Georgia represents a significant factor in Atlanta's growth. The company employs more than 26,000 persons.

With such massive work forces in its midst, Atlanta has changed from a city with limited recreational offerings to one brimming with nightclubs and sports attractions.

The city's fondness for stock-car racing, golf (Bobby Jones is an Atlantan), and tennis

Glittering gala for a palace of the arts! Celebrating the opening of the Atlanta Memorial Arts Center on October 5, Mme. Charles Lucet, wife of the French Ambassador to the United States, slices a cake modeled after the colonnaded structure. The center commemorates the 122 Atlanta art patrons who died in a 1962 air crash in Paris. Under one roof it houses the High Museum of



stretches back over many years, but now there are major-league baseball and professional football, soccer, and basketball. Lake Sidney Lanier, 50 minutes from Atlanta by car, attracts the boating enthusiasts (pages 262-3).

Atlanta completed a magnificent sports stadium in 1965, before receiving written assurance that a major-league baseball team would move in. Happily, the Braves came from Milwaukee, and the city greeted them with cheering crowds (page 259).

Another attraction of wide appeal is Stone

Mountain, the largest isolated body of exposed granite in the world. Atlantans don't mind that the mountain is lopsided and ugly, that it rises 825 feet above the surrounding lowlands like a defunct whale floating on calm water, that it's hard and cold, and bald as a light bulb. It remains enshrined in their hearts.

Stone Mountain is the centerpiece of Stone Mountain Park, a 3,800-acre recreational facility developed with state and private resources as a monument to the Confederacy. The park offers hiking, camping, museums,

Art, the Atlanta School of Art, and the Atlanta Symphony Orchestra. Ballet, repertory theater, and opera companies perform on its four stages.

Crowning art treasure, a bronze casting of Auguste Rodin's "L'Ombre" (The Shade) arrived as a gift from the Government of France. The figure, head slumped in anguish, came from the composition "The Gates of Hell."



Giants of old—the State Capitol with its dome sheathed in Georgia gold, sprawling state office buildings, and City Hall, left—share downtown with taller titans. In this northward view, the 41-story First National Bank, center, National Bank of Georgia, and the skeleton of the Equitable Building. “Living, breathing, growing every hour,” said Atlanta editor Henry Grady in a speech on the New South in the 1880’s, and his city still epitomizes that progressive spirit.

ROBERT HENRI © R.A.P.

an ante bellum plantation, fishing, children’s zoo, aerial cable cars, horseback riding, riverboat and steam-train rides, a motel, and concerts on a 732-bell carillon. But the crowds come to see, touch, and climb the mountain.

On a side of the granite wonder, one of the largest sculptures in the world nears completion. The carving, in a niche 305 feet across and 195 feet high, honors the Confederacy’s three greatest heroes, Jefferson Davis, Robert E. Lee, and Thomas J. (Stonewall) Jackson (pages 276-7).

Work on the actual carving began in 1923 and continued off and on until 1928, when funds ran out. The latest effort began in 1964 under direction of sculptor Walker Hancock of Gloucester, Massachusetts.

Artistry Reduced to Arithmetic

In a closet-size elevator I climbed to the 33-story level of the mountain and stepped out on a narrow catwalk near General Lee’s 26-foot forearm. Roy Faulkner, the chief stonecutter, laid down the thermo-jet torch with which he carves granite and told me:

“Everything I do on the side of this mountain is mathematical. I work with measurements taken from the model. There’s no guesswork. I can’t back off and look at my work.”

My thoughts turned from the massive sculpture to the Civil War, and to the man who burned Atlanta.

Fifteen years after the siege and fire, General Sherman returned to the city as guest of honor at a reception; it was on this occasion that he made his prophecy about Atlanta’s bright future. As his train rolled to a stop at the depot, someone in the crowd shouted, “Ring the fire bells! The town will be gone in 40 minutes!”

But, strangely, the Atlantans seemed to hold no hatred; only wonder for a man who could burn their city and see—more clearly than they—a destiny of greatness written in the ashes.

THE END







Ancient Shipwreck Yields New Facts — and a Strange Cargo

By PETER THROCKMORTON

Photographs by KIM HART

and JOSEPH J. SCHERSCHEL, National Geographic Staff

DURING THE EARLY Christian centuries, wooden merchant ships carried the trade of Imperial Rome to the farthest reaches of the Mediterranean. Gale and accident took their toll, and the doomed craft left their skeletons on submerged reefs and sand bars and on the bottoms of anchorages that could not protect them from the siroccos and other vicious winds that scourge the "Sea in the Middle of the Land."

Pottery and marble, nails of copper and bronze, coins and other metal objects have lasted out the ages to mark sites of many of these wrecks. Rare it is, however, to find intact the wood of these vessels' hulls. Over the centuries, the pine, oak, elm, Lebanon cedar, and cypress that formed planks and timbers have rotted away, been devoured by worms,

or suffered decay in the embrace of sea plants.

But in 1967, diving to a Roman wreck I had found in the Gulf of Taranto in southern Italy, it was my extraordinary good fortune to lift from the bottom pieces of ship's planking, much of it broad-hewn pine, looking as yellow-fresh as the day it was felled. Wooden nails and tenons still joined timbers cut from trees that grew before Christ walked the stony hills of Palestine.

What was there about this wreck that had allowed such an archeological treasure to be preserved over so great a span of time? The explanation is the cargo—chiefly marble coffins. Scores of tons of precut sarcophagi and their lids, architectural blocks and smooth panels, all lay disposed pretty much as they had been loaded on the ship nearly 18 centuries

The first hull plank of a drowned Roman ship returns to the surface of the Gulf of Taranto with archeologist-diver Peter Throckmorton. After locating the wreck and its cargo of marble coffins, the author and his crew spent two summers salvaging them. Divers gleaned information permitting reconstruction of a Roman merchantman with greater accuracy than ever before (painting, above). Carbon dating indicates the ship was built of wood that grew in the first century B.C. She sank when old and patched, more than two centuries later.



ago. This massive burden had weighted down the timbers. Protective sands built up over the wreck site, sealing away the wood from all elements except salt water.

We had come to the Gulf of Taranto, under the boot of Italy, following a hot trail that started off Methoni near the southwestern tip of Greece (map, page 287). Bits of pottery found there, under a sunken cargo of half-finished granite sarcophagi, allowed us to date that wreck in the third century A.D. We deduced that the vessel had been bound for Italy. At Ravenna archeologists have found identical stone coffins.

A paper I had published on the Methoni wreck caught the eye of Professor John Ward-Perkins, director of the British School at Rome and an expert on the Roman marble trade. Professor Ward-Perkins had read reports of sunken shiploads of marble off France and Greece, and especially in the Gulf of Taranto.

Italian divers, sent out by the National Museum in Taranto before World War II, had explored a wreck full of marble sarcophagi, but they stopped salvage when they found that the coffins were not sculptured.

Quest for Wreck Site Begins

Encouraged by our Greek find, Professor Ward-Perkins suggested to Dr. Froelich Rainey, director of the University of Pennsylvania Museum, that exploration of the Gulf of Taranto should prove productive.

My own specialty, as a research associate of the University Museum, has been locating and identifying ancient shipwrecks. I was lucky enough to find the fascinating wrecks at Cape Gelidonya and Yassi Ada that Dr. George Bass and I have described in four *GEOGRAPHIC* articles.⁶ But I still yearned to discover a ship of the Roman era with enough wood preserved to provide the basis for accurate reconstruction drawings.

In the spring of 1964 Professor Rainey sent me to Taranto to search for the abandoned sarcophagus wreck. There I was joined by redheaded John M. Bullitt, a professor of English at Harvard. As a summertime diver John had worked with me on the Methoni wreck. An old Volkswagen bus, a compressor, and Aqua-Lungs comprised our equipment.

The director of the Taranto museum, Professor Attilio Stazio, reminded us that the

⁶See in the *GEOGRAPHIC*: "Thirty-three Centuries Under the Sea," May 1960, and "Oldest Known Shipwreck Yields Bronze Age Cargo," May 1962, both by Mr. Throckmorton, and "Underwater Archaeology: Key to History's Warehouse," July 1963, and "New Tools for Undersea Archeology," September 1968, by Dr. George F. Bass.



original finders had all died, and no one remembered the wreck's location. Some fishermen believed it was near a place called Torre dell'Ovo—locally translated as "tower of the sheep."

John and I drove along the flat coast to Torre dell'Ovo, a 16th-century watchtower built in Apulia to protect the coast against Barbary pirates. Last used as a radar post during World War II, the tower was now abandoned to rats and passing vandals.



EXPLORING BY JOSEPH J. THROCKMORTON © R.S.S.

A concrete dock, base of operations for tuna fishermen, projected into the bay near the tower. The water shone clear and blue in the blazing midday sun, and we decided to go for a swim and try to spear our lunch.

I saw an octopus, then another. We caught them both. A dozen unshaven fishermen in tattered trousers and undershirts were tying up their big rowing boats as we came ashore. They nodded approvingly when I began pounding the octopuses on the dock to make

Map of the marble trove, plotted by expedition divers, guides the author, second from left, and Italian salvagers as they plan to raise 39 sarcophagi and marble blocks from 36-foot depths off Torre Sgarrata—"the broken tower." Later the barge with its heavy crane, background, moved the stones to Taranto for exhibition. Divers found the wreck before World War II, but its location was forgotten until Throckmorton rediscovered it in 1966. Two coffins were left to mark the site for future archeologists.



UNDERWATER BY JOSEPH J. SCHERER © N.Y.S.

Hungry sea snake, a vacuuming air lift devours tons of sand hiding the shipwreck and exposes the eroded marble. Compressors pump air down the small hose, center, and into the tube's mouth, creating suction.

Diver in the foreground picks out potsherds and other small artifacts before the sand gushes away. Last task on his underwater shift: double-checking the sand dumped beyond the wreck. Fragments of pots made near Smyrna indicate the ship had stopped at that ancient port.

them tender. When I had finished, a slight, dark man, apparently their leader, came over and offered us cigarettes.

"Where you from?" he asked.

In our broken Italian we told him that we were Americans.

"I've got a lot of cousins in America. Glad to meet you. My name's Francesco."

He was the boss of the *tonnara*, the complex of offshore tuna nets which eventually lead the frightened fish to a trap.

"The *camera della morte*," said Francesco with a gruesome chuckle—"room of death."

He and his men invited us to share their lunch of black bread—Francesco owned a bakery, too—goat cheese, and red wine. We asked about the wreck and mentioned that we were looking for a place to stay.

"I don't know anything about your sarcophagi, but I'll ask around," Francesco said, with a conspirator's wink. "For your other problem, I've got the solution."

He reached into the pocket of his greasy jacket and produced a bunch of black iron keys. One was as big as my hand. He waved toward the tower.

"You can stay there all summer if you like." He was, it seemed, also official guardian of the tower. "I look for your wreck, you look for the net anchors I keep losing. Okay?"

"Okay," we replied in unison, and that was the beginning of our three summers as the tenants of Torre dell'Ovo.

Hopes Stirred by Sight of Marble

During the following weeks John and I kept hearing stories of strange things in the sea. We found the sunken remains of Roman harbor works, and several shipwrecks badly broken up in shallow water, but no trace of the wreck full of marble blocks.

My wife Joan joined us and, just before John Bullitt had to leave for the United States, Francesco left a message to come see him.

I found him at the dock, supervising the loading of the day's tuna catch into his truck. He slapped me on the back.

"I know where it is. Let's go!"

Ten minutes later we were on the coast road. Just past a settlement called San Pietro, he pulled up his truck, jumped out, and walked to the edge of the water.

"Swim there," he said.

As I swam over the sandy bottom, a square shape loomed through the clear water—a sarcophagus rough-cut from beautiful white marble. Not far away lay another, and then I saw a whole heap of unfinished sarcophagi.



Ship-killing coast of the Gulf of Taranto claimed many vessels swept shoreward by violent winds. Sixteen known wrecks include the sarcophagus ship off Torre Sgarata, which sank in shoal waters 500 yards from shore. Her marble cargo presumably came from quarries near famed Aphrodisias in Asia Minor. Like other mariners of the day, the Rome-bound skipper shunned open seas when possible, preferring to keep land in sight.



Floating command post, the salvage ship *Archangel* rides at anchor above the wreck. Ships similar to this Greek *perama* have plied the Mediterranean for 2,300 years.





Bare bones of an ancient argosy, the pine hull planks of the sarcophagus ship lie free of the sand that protected them for 18 centuries. Ignored by the fish, the author's wife Joan sketches the wreckage with lead pencil on a plastic plate. Artist-divers mapped every piece of marble and timber—tagged here with coded squares—before raising them. The ship's tough elmwood keelson lies beneath the marble block at upper right; fragments of frame and stringers survive atop the planking



UNDERWATER BY TIM ARNT © NATIONAL GEOGRAPHIC SOCIETY

in foreground. Unlike modern shipbuilders, who overlap or caulk planking, Greek and Roman shipwrights used mortise-and-tenon joints to fasten the hull planks edge-on-edge, counting on the water to swell the wood and prevent leaks. Patches of inferior wood and traces of fast-rusting iron nails indicate repairs to the ship when she was already old, by an owner who hoped to sail her a few more years. A coin in the wreck (page 291) proves she sank no earlier than A.D. 180.

"You happy now?" Francesco asked when I got back to the beach. Without waiting for an answer, he stomped off, grunting that he had to get his fish to market.

Joan and I and my stepchildren Mark and Sarah, aged nine and seven, spent most of the summer surveying this sarcophagus wreck at San Pietro. An inflated inner tube with a Maine lobster bag suspended in it held our simple survey tools—tape measure, carpenter's ruler, pencil, and plastic slate.

Finally we hired a motor launch and air-lifted tons of sand off the site. Frustration.

Nothing of the ship remained. We found only some lead and half a dozen potsberds.

I was disappointed, but our sarcophagi delighted John Ward-Perkins. He concluded that the stone was indistinguishable from that quarried in the area of famed Aphrodisias in Asia Minor.* The coffins were blanks for intricately carved sarcophagi of the Imperial Roman period, examples of which are in the Metropolitan Museum of Art in New York City and the Terme Museum in Rome.

*See, in the August 1967 *GEOGRAPHIC*, "Ancient Aphrodisias and Its Marble Treasures," by Kennan T. Erim.



Key to a forgotten craft, the step that once supported a forward mast reveals an aspect of ancient ship construction previously only hinted at in old floor mosaics. The Roman merchantman's forerunner of a bowsprit carried a steering sail, or *artemon*, that raked forward over the bow (page 282). Rectangular socket in the elmwood step held the heel of the mast. Stringers on timbers running the length of the ship's bottom fit into the notches cut in the left side of the step. This rare relic of Mediterranean shipbuilding is seven and a half feet long and weighs about 800 pounds.

The ship, illustrated on the title page, measured about 90 feet stem to stern, with a 25-foot beam.



Wooden nails stud a chunk of pine planking that crumbled like hard cheese when handled. The treenails held the planks to the frame.

Ten thousand measurements taken underwater help archeologist-artist Diana Wood reconstruct the sunken ship's hull design.



Soon the first fall sirocco boomed into the Gulf of Taranto, putting an end to our work for that year. For a week it blew, seldom less than 40 miles an hour, with great gusts of more than gale force. In a storm as strong as this, a clumsy Roman sailing ship would never have been able to bent out of the gulf.

Such winds help explain why we found so many shipwrecks in the area. The unlucky vessels had been caught on their way from the east, after clearing Cape Santa Maria di Leuca at the heel of the boot, while heading for Messina, Sicily, and on to Rome.

Returning to Taranto in 1965 with my family, I heard fishermen's tales of a "sunken city." But no one could pinpoint the site.

When the break finally came, there was almost no drama to it. A boatman, Midio La Gioia, told us that the sunken city consisted of a cluster of columns on the bottom a quarter of a mile offshore in the little bay east of Torre Sgarrata, "the broken tower." His grandfather, he said, had discovered the place.

Midio took me to the spot and I dived from his boat, finding myself on a featureless sandy bottom. I surfaced. "Nothing here," I said.

Nature's stained glass, a back-lighted slice of Oriental alabaster, or onyx marble, glows with translucent elegance.

The author and the expedition's associate director, William Phelps, right, had it cut from a block of the stone found in a sarcophagus. The highly prized alabaster rode to Italy to be used in windows and as decoration for monuments and buildings. Thin slabs of white marble, fragile as plate glass, were also stored in the coffins for shipment.



APPROPRIATED BY JOSEPH J. NEWFINGER, JR. N.Y.S.



Handmade bronze spikes reveal hammer marks. Four to ten inches long, they fastened planks to hull frames. Archeologist Phelps finds that some appear new despite centuries in salt water.



Telltale clue, this bronze coin found in the wreckage helps date the disaster. It was minted on the island of Lesbos between A.D. 180 and 192, during the reign of the Roman Emperor Commodus, seen in profile.



REARRANGED BY JOSEPH C. SCHERER, JAMES AND SARAH THOMAS © 1994

Token of teamwork: The author presents Adm. Salvatore Pelosi of the Italian Navy with a copper spike recovered from a sunken American naval vessel, the Civil War veteran *New Hampshire*. The old square-rigger went down in 1922 off Massachusetts; divers of the Boston Sea Rovers Club retrieved many of her spikes, of a type first made in the United States by Paul Revere. The admiral helped in salvaging planking and marble of the Torre Sgarrata wreck and in providing a museum for them in Castello Sant' Angelo (opposite).

Last port of call. The Castello Sant' Angelo of Taranto, not Imperial Rome's marble yards, becomes the final destination of the shipwrecked cargo. Here the salvage ship *Archangel* unloaded the wreck's hull planking for exhibition with the marble. The timbers now soak in special tanks to prevent shrinking and crumbling. Later a chemical will stabilize the relics by replacing sea water in the fragile wood fiber.

Midio chugged two hundred feet to one side. Without enthusiasm, I jumped in again.

Through the clear water I saw two sarcophagi protruding above the sand. I swam down and fanned with my hand. The sand, feather light, drifted away in a cloud. Like the sarcophagi at San Pietro, these were of white marble, and in very good condition.

To the Surface With an Exciting Report

Thirty feet away, a massive shape loomed. It was a huge block of eroded marble, probably a rough-cut column. A trawler's net had snagged on it. Beside it lay two more sarcophagi, barely visible above the sand.

"The sand is high this year," Midio complained when I surfaced joyously and reported. "Normally you can see dozens of blocks."

Fixing our position, I felt certain that we had found *the* wreck. The ship had sunk here on the six-fathom line, where the great seas of

the south gale, after running free for hundreds of miles, rose in their first break on the shoaling shore.

French diver Claude Duthuit turned up in midsummer, adding a very experienced member to our team. We rented a converted lifeboat, loaded aboard the big air-lift pipes and two gasoline-driven compressors, and started to dig away the sand.


We quickly proved Midio right. Marble blocks crowded the whole area. Within a week we had uncovered 15 of them.

The climax of that summer's search came the day I decided to give my wife Joan a lesson on the air lift. We went down to the wreck wearing Aqua-Lungs and flippers, and hung head down between the white sarcophagi 40 feet beneath the surface.

With one hand Joan steadied the sheet-iron pipe we were using to "vacuum" the sea floor, with the other she tried to fan the sand and







UNDERSEA AIRPOWER lifts a marble sarcophagus from the sandy bottom. The author fills the plastic balloons with air from the hose, right. Then a team of divers will guide the massive stone coffin to a nearby parking area, whence it will be hoisted to the surface by crane. Doughnut-shaped marker numbers another sarcophagus.

ADDACHROME BY KIM HART © N.O.L.



PHOTOGRAPH BY WILLIAM A. SCHNEIDER © 1967

Where ancient sailors fought the sea, expedition members cut quiet waters in a dinghy. On the horizon, the broken and abandoned watchtower of Torre Sgarrata overlooks the bay it guarded against raiding Barbary pirates of the 1500's.

matted eelgrass toward the suction tube.

Fighting the powerful kick of the air lift, Joan had dug down between the stone coffins. Wedged beside her, I reached under a block of marble and felt what seemed like just another lump of hard-packed eelgrass. It came away in my hand, and I saw that it was a bit of rotten pine, with a wooden nail and a tenon.

The wreck had yielded up its first piece of Roman wood!

To excavate this wreck properly, we needed more money, a bigger crew, and most of all a boat large enough to stay moored over the site when the south wind blew.*

Two years passed, and then, in the harbor of Poros in Greece, we found *Archangel*, the type of boat Greek sailors call a *perama*. She

was 23 years old but her hull resembled those of vessels that sailed 23 centuries ago (page 287).

The old boat seemed sound—nothing wrong with her mulberry frames and cypress planking that could not be fixed by cleaning and painting. Capt. Manolis Kaliskamis, her owner, had tears in his eyes when we shook hands.

"She is a good boat. I raised my children with her; she will feed yours too. . . ."

Archangel was ours. An archeologist friend, William Phelps, who had inspected the boat with me, agreed to come to Italy as associate director. In the spring of 1967, we sailed *Archangel* to Piraeus, and the rest of the crew began to assemble.

Sanford (Sam) Low, our "executive officer," had just served his tour as a naval reserve lieutenant on a tanker off Viet Nam. Terry Vose from Boston signed on to look after *Archangel's* primitive engine and our four cantankerous compressors. Sam's cousin, Kim Hart, came along as sailor, photographer, and diver.

A retired Greek sea captain, friend of *Archangel's* former owner, joined us as bosun and man-of-all-work. His name was Manolis, too. He had grown tired, he told us, of sitting around the house with the women all day.

Captain Manolis and Joan made friends, not a simple thing in the Mediterranean world where it is

considered bad form for women to scrub out bilges with lye. It was Joan's proudest day when the Greek skipper trusted her with the blowtorch while he worked along with the scraper, and together they cleaned 20 years of paint from deck and scuppers.

In the middle of June 1967, we sailed *Archangel* from Greece to Taranto. When we arrived, we found to our astonishment that most of our diving machinery was in working order and ready to go. Joan, who had been sent ahead in May to prepare for our arrival, modestly explained, "I told the men my husband

*Support for the expedition included funds from the Littauer and Old Dominion Foundations, the United States Liaison Committee for Oceanographic Research, the University of Pennsylvania Museum, and from several individuals.

would beat me if everything wasn't ready."

We moored *Archangel* over the wreck and began digging with the air lift. As the great pit on the bottom sank deeper, we kept finding more and more sarcophagi.

The sand also held thousands of fragments of the half-inch-thick marble sheeting which had formed part of the ship's cargo. One sarcophagus, fortunately, stored intact seven of these fragile marble panels.

By mid-July we had moved perhaps a thousand tons of sand. Now our air-lift diggers began to uncover a lot of wood pinned under the sarcophagi. Imagine our excitement to find planking. Big pieces of pine were fastened together with oak tenons, construction like that of the third-century B.C. ship Captain Cousteau had excavated at Grand Congloué.*

What a task for our draftsmen! Joan and archeologist-artist Diana Wood made most of the drawings (page 290); artist Joe Conroy assisted with measurements which by summer's end totaled 10,000. As each piece was uncovered, they had to draw in every nail and nail hole, every mortise and tenon, every mark on the wood while underwater (page 288).

One day Diana watched in fascinated horror as a whole section of hull planking began to ripple slowly up and down. Soon two eyes and four arms appeared at one edge of the section: An octopus was making his home beneath our flimsy ruin.

In many places the planking looked almost freshly cut. The newly uncovered pine shone breathtakingly bright yellow, but darkened in the sea after very few days. The frames were in a much poorer state of preservation, blackened by rot and far more fragile.

We found pieces of hull with characteristics previously known only from ancient mosaics. One cherished object was the step for the forward-raking foremast that held the *artemon*, or steering sail (page 290).

Pottery Confirms Date of Sinking

Digging into the deepest layers of the wreck, we began to find potsherds by the hundreds. They helped us date the ship. Most of the pots seemed to be Imperial Roman, from the end of the second century A.D. or a little later. Definitely not Italian in style, they probably came from Asia Minor. We found pieces of fine plates, bowls, and jugs that may have graced the captain's table, and bits of cooking pots blackened by the galley fire.

*See in the *GEOGRAPHIC* for January 1954, "Fish Men Discover a 2,100-year-old Greek Ship," by Capt. Jacques-Yves Cousteau.

The skill of the shipwrights who had built our vessel nearly 2,000 years before stirred our sense of wonder. Unlike modern vessels, ours had no caulking between the heavy planks. They had been fastened edge-to-edge with mortises and tenons, and were so well matched that the swelling of the wood in water was enough to make the ship watertight.

The wood of the hull shrank and twisted when it dried. Odd scraps of planking left in fresh air turned to dusty punk almost at once.

Macabre comic, skin diver Fabio Ferro tries on a sunken coffin for size. Sarcophagus means "flesh-eater," a name deriving from the corrosive effect of early limestone coffins on bodies interred in them. Through the centuries, farmers have taken many ancient sarcophagi for use as watering troughs.

PHOTOGRAPH BY FIM HERT © R.S.O.



"The cellulose in the wood, through the centuries, has been replaced by sea water," explained our conservation expert, David Leigh of the University of Southampton.

To preserve the wood, David told us, we would have to place it in a bath of simmering water and an inert chemical compound called Carbowax 4000 that would prevent the wood's shrinking or crumbling as it dried. The bath would flush out the salt from the wood and, as the water evaporated, it would be replaced by the Carbowax, until after some months the water would completely disappear. The wood would then be stable and could be studied and exhibited. This was the same chemical used to preserve the three-centuries-old *Vasa*.*

Each day we were uncovering more and

more wood. Finding space for treating and storing it became the next order of business.

Thanks to Professor Stazio and Adm. Salvatore Pelosi (page 292), space for a maritime museum was found in the Castello Sant' Angelo, the Italian Navy's local headquarters. Inside this 15th-century fortress, commonly known as the Aragonese Castle, a series of preserving tanks designed by David were built by a skilled mason.

Archangel Faces a Test

At the wreck site, to get at the wood, the crew had to remove the remaining marble sarcophagi and blocks, the heaviest weighing

*See "Ghost From the Depths: The Warship *Vasa*," by Anders Frøen, *GEOGRAPHIC*, January 1967.



12½ tons (below). To set the marble aside in a parking area, we soon had an efficient balloon lift in operation (pages 294-5).

When a dozen or so sarcophagi had been ballooned out of the wreck, I arranged for a navy crane on a barge to pick them up. Then, with the holding tanks at Sant' Angelo ready, we began moving the wood, this time with *Archangel's* cargo winch. We laid the timbers in made-to-measure racks, wrapped them in plastic sheeting, and rigged slings underwater to lift each piece to *Archangel's* deck. At the castle dock in Taranto navy sailors helped unload the wood into the tanks.

As the summer waned, the weather worried us more and more. Kim, Sam, and Joan were taking turns on the air lift one morning when

a storm blew up. In less than an hour the wind went from flat calm to a full gale. *Archangel* heaved so hard against her mooring that it seemed the whole bow would rip off.

Sam was hunting for an ax to cut the ship free when all three heavy mooring ropes parted at once and the ship drifted toward shore. The crew was able to set a sail and claw off the rocky coast, anchoring a mile away, when the gale abruptly ceased. The squall had split the foremast, overturned both dinghies, and blown the furled awning overboard.

It became clear that we could not finish the excavation that year. So we limited our work to recovering wood that might be destroyed by the winter's storms.

On the shore side of the wreck, where the



EXCAVATIONS BY GABRIEL TROCKMORTON (LEFT) AND JEREMY J. SCHROEDER © M. & B.

"What master's hand hefted you?" Throckmorton seems to ask this marble-carver's mallet found in the sand. Made of elmwood and chipped by use, it closely resembles the mallet of a sculptor or mason of today.

Fallen empire's building block, a 12½-ton chunk of marble breaks from the sea before Throckmorton, third from left, and Italian Navy and salvage men. The author hopes to return to the wreck site with modern metal detectors to find the vessel's missing anchors and add them to the exhibition.

planks were deeper in the sand, the great wales, or rubbing strakes; of the prow still stood in place. There, during our last week, we began to uncover coins and other bronze objects, including a coin of the Emperor Commodus (A.D. 180-192). Dozens of beautifully made bronze nails turned up (page 291). They had fastened parts of the ship below waterline. A thrilling find was the bronze shoulder strap from a Roman breastplate.

On the next-to-last day we removed a section of planking, and there in the sand, almost perfectly preserved, lay a mason's elmwood mallet (preceding page). Nothing else we found made us feel so close to those men we had come to admire so much, the anonymous technicians who built Imperial Rome.

To complete our work on the sarcophagus wreck, we returned to Torre Sgarrata early in August 1968. During a three-month season under conditions more storm-tossed than in earlier years, we brought up—helped again by the crane power of the Italian Navy—15 more marble blocks and panels.

The work on the Torre Sgarrata wreck has resulted in the partial reconstruction on paper of the hull of a Roman cargo ship of the second century A.D., one of the vessels that ran in the eastern trade at the height of the empire's glory. From our drawings of planking, frames, and stringers, we project a plan that shows a vessel of about 90 feet in overall length and 25 feet in beam (page 282).

Tests indicate that the ship's timbers grew in the first century B.C. Dr. Elizabeth Ralph at the University Museum radiocarbon laboratory has subjected to carbon-14 analysis a sample from that very first planking that Joan and I found in 1965.

Allowing a margin for error, the ship was probably built no later than the first century A.D. In all likelihood, she was going about her business when Paul was preaching Christ's gospel throughout the ancient world.

Patches on Hull Tell a Sad Story

Dr. B. Francis Kukachka of the U. S. Department of Agriculture's Forest Products Laboratory at Madison, Wisconsin, has analyzed the wood from the wreck. He reports that the brushwood sticks of salt cedar (*tamarisk*), which were used as packing between frames and planking, very probably grew in Asia Minor or Egypt.

The ship was old when she sank. Our most exciting find of the final month of excavation

was a piece of the hull showing a perfectly preserved wooden patch. A thin slab of wood had been fastened in place over the heavy original planking with wrought-iron nails. The iron had long since rusted away, leaving only black stains to mark where the nails had been.

This use of iron was in striking contrast to the care taken by the master shipwrights who made the original hull. They had used only bronze nails below the waterline. The shoddy patching spoke eloquently to us of a good ship growing old and falling on hard days.

To Italy With a Heavy Cargo

We know enough to attempt a reconstruction of the ship's last voyage. Like dozens of her kind, she loaded her cargo of half-finished sarcophagi and marble blocks on the Turkish coast, perhaps in Miletus (map, page 287). She may have set sail late in the summer, stopping for additional marble at Greek island ports.

Rounding the Peloponnesus, she beat northward along the Greek coast, staying in sight of land as long as possible. At last she swung westward across the Ionian Sea to Cape Santa Maria di Leuca at the tip of the heel of Italy. She then set course for Messina.

That night the wind must have changed. From the south the dreaded sirocco began to blow. By midnight, his ship laboring heavily, the anxious captain would have put lookouts in the rigging. At dawn they sighted land. With her great square sail, and her heavy load, the ship did not go well to windward. She was trapped in the Gulf of Taranto.

The captain ordered the anchor out in 15 or 20 fathoms. As the gale increased, the first anchor dragged and the doomed ship inched toward shore. The first anchor and then another were lost as the stout cables broke.

In the deepening darkness, the big ship worked inexorably toward the six-fathom line, where the long seas curled to break.

The gale shrieked louder. Nothing to do but cast out all remaining anchors. That—and pray, as St. Paul did in like circumstances, for dawn. If the vessel survived until daylight, there was a chance—just a chance—to run her ashore, accepting the loss of ship and cargo but saving the lives of those aboard.

It was the captain's last gamble. His ship foundered that night, five hundred yards offshore. The old vessel had given up at last, as old ships must when pushed too hard, especially when the owners make repairs with black iron in place of gleaming bronze.

Watch "Australia: The Timeless Land," a color TV special, on Tuesday, February 18

Australians call it simply the outback, this hostile heartland of their continent. Modern pioneers, lured by land and minerals, brave its crushing heat and isolation. Meet this special breed on Tuesday, February 18, when the National Geographic Society presents the third in its 1968-69 color television series, "Australia: The Timeless Land."

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This hour-long documentary, narrated by Alexander Scourby and telecast by CBS, is produced by the National Geographic Society in association with Metromedia Producers Corporation (MPC). Sponsors are Encyclopaedia Britannica, Inc., and Hamilton Watch Company.



Illustration by Robert A. Sargent © R.A.S.



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Masked by powder, an aborigine portrays an emu in a ceremonial hunting dance. His people struggle to leap from Stone Age to Atomic Age.



Illustration by Robert A. Sargent © R.A.S.

Gaiety in a grotto: Music enlivens the underground home of opal miners in Coober Pedy, or "white man's burrow."

Living Teddy bear, a koala contentedly munches leaves of the eucalyptus tree.

Huddled like a sphinx, solitary Ayers Rock rears a wrinkled flank 1,143 feet above scrub plain in central Australia.

Overleaf: Drovers herd a mob of cattle at Jilka station in the Northern Territory.



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COVER: Ears spread wide, a battle-scarred Kenya tusker whirls to confront an intruder (page 151).

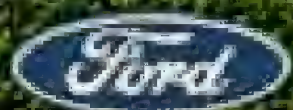
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hassee. A National Geographic Society grant made possible the recovery of the eight-ton giant, nicknamed Bertha by its discoverers.

Diver at left inspects the find; at right, Dr. Webb lifts a 75-pound, 3½-foot-long leg bone 40 feet to the surface beneath an air-filled plastic bag. By next year, visitors will be able to see Bertha's awesome, 15-foot-high skeleton in a new museum on the university campus in Gainesville. Your Society dues make such projects possible. Give friends the opportunity to add their support; nominate them for membership below.

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Fish used to be scared when we

Not long ago, the oil industry usually looked for offshore oil with dynamite. They exploded it underwater and recorded the telltale echoes on a seismograph.

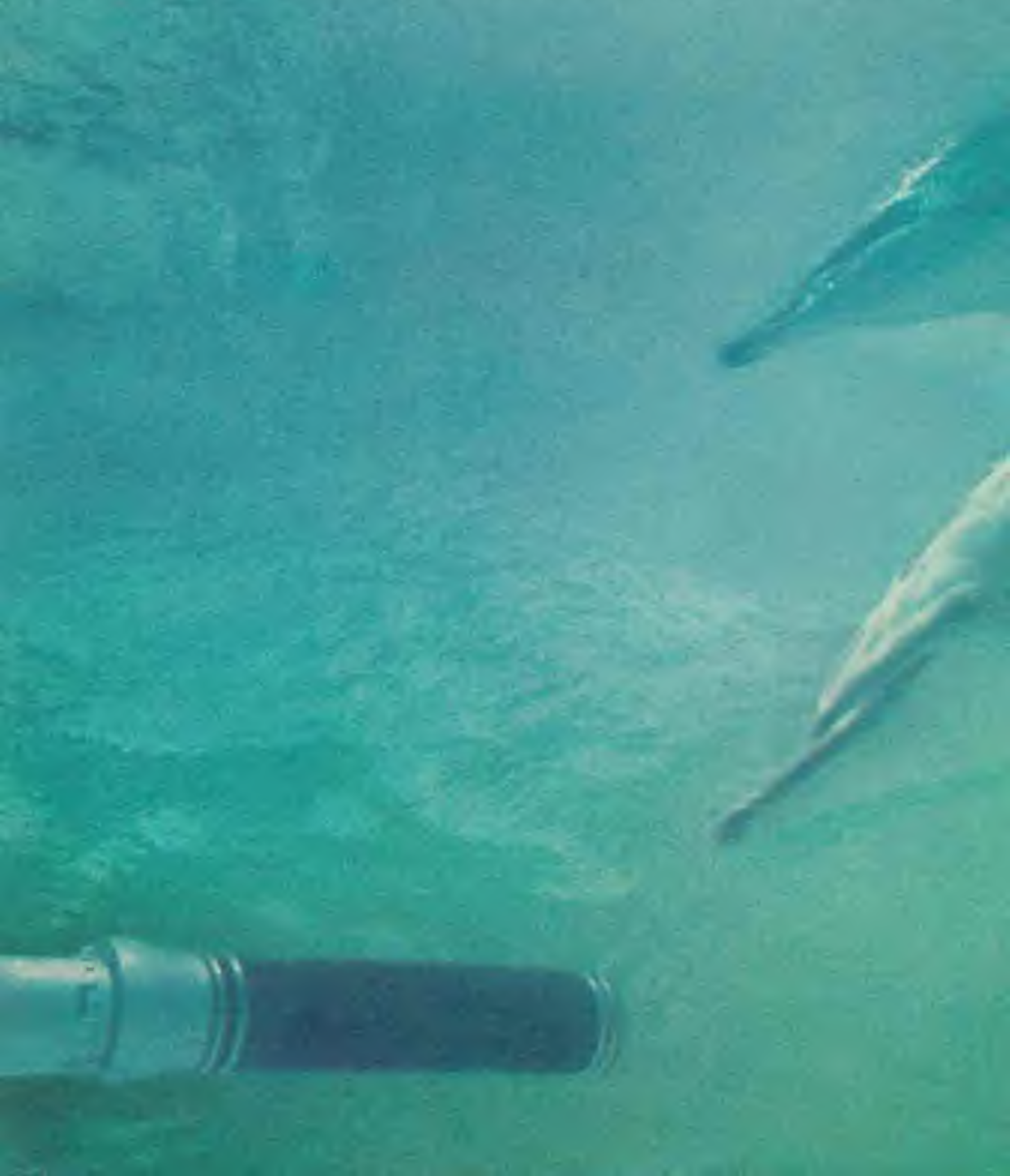
When carefully done, this did little or no harm to aquatic life. But fish were sometimes scared and fled to quieter waters. Fishermen frowned. They had to go farther to fish.

Now, the Esso Production Research Company (a Jersey affiliate) has invented a substitute

for dynamite. We have nicknamed it the popper and you can see one at the bottom of our picture. It doesn't go bang like dynamite. It simply goes pop.

The device is beautifully simple. A mixture of propane and oxygen is ignited by a spark plug inside a rubber sleeve. The pop inflates the sleeve like an instant balloon.

This sudden expansion is fast enough to give a seismic echo, but not fast enough to



looked for oil. Now they seem interested.

scare away fish, porpoises or anything else.

What's more, it has a snorkel. This allows burned gases to escape to the surface. So the water stays clean.

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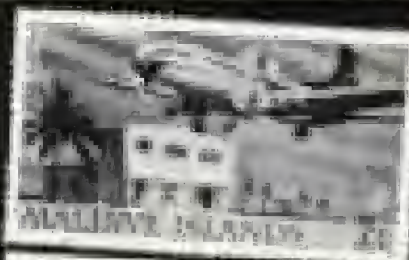
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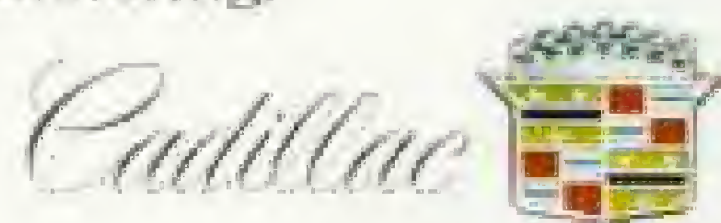
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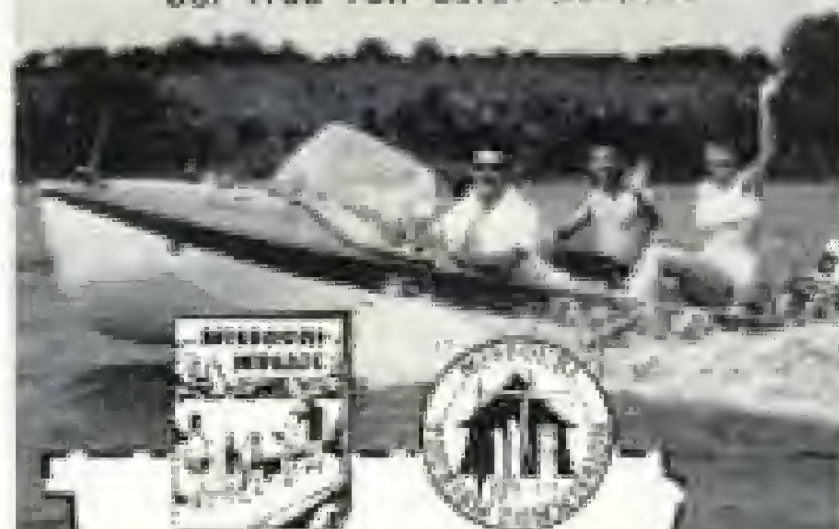
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